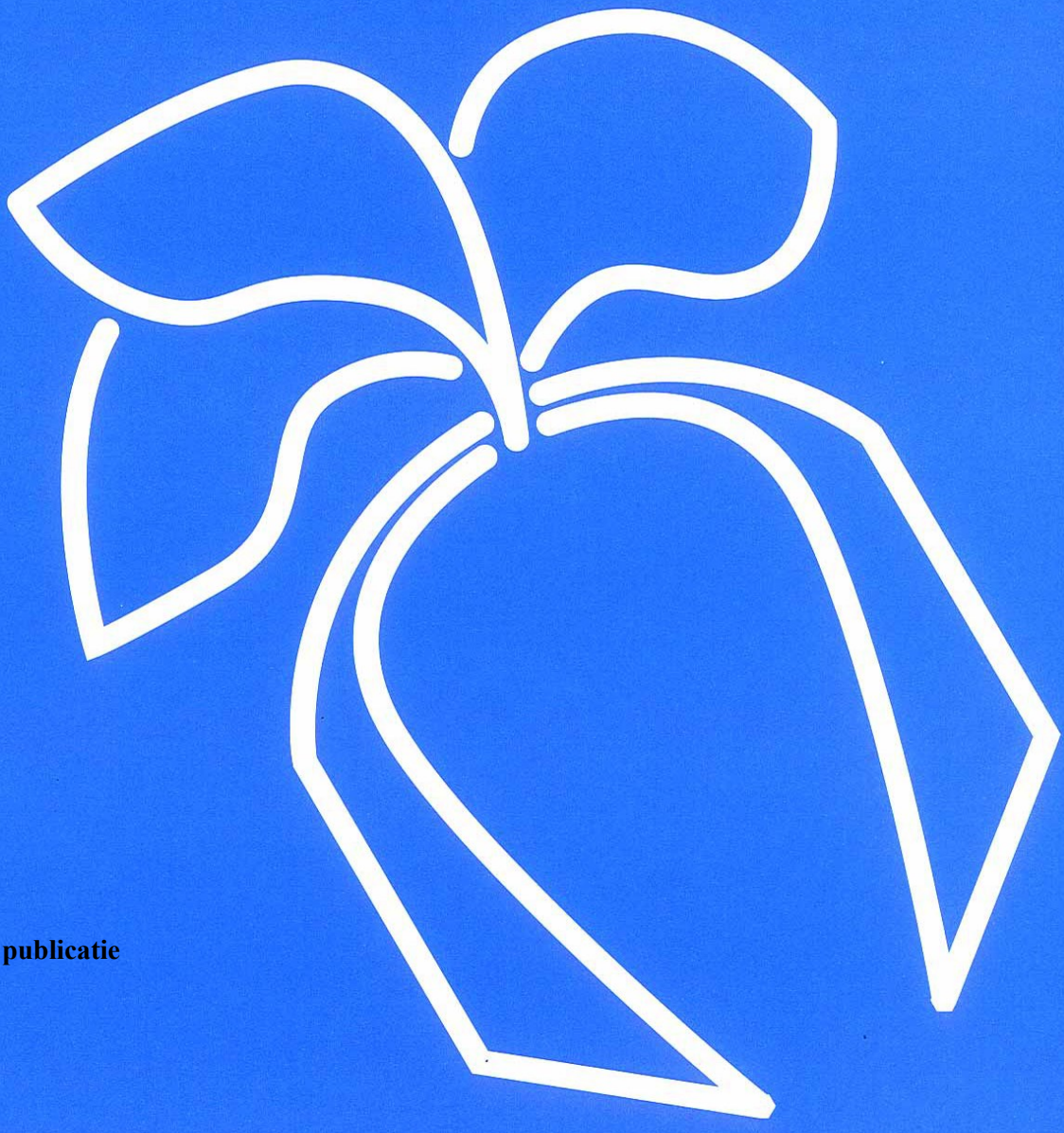
# Research on the efficacy of different insecticides to control the green peach aphid (*Myzus persicae*), the black bean aphid (*Aphis fabae*) and Beet Mild Yellowing Virus (BMYV) in the Netherlands in 2020

**Elma Raaijmakers (IRS)**



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# Research on the efficacy of different insecticides to control the green peach aphid (*Myzus persicae*), the black bean aphid (*Aphis fabae*) and Beet Mild Yellowing Virus (BMYV) in the Netherlands in 2020

**Elma Raaijmakers (IRS)**

**Stichting IRS**
**Postbus 20**
**4671 VA Dinteloord**
**Telefoon: +31 (0)165 – 51 60 70**
**E-mail: irs@irs.nl**
**Internet: http://www.irs.nl**

 **Project: 11-02**

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## Samenvatting

Vergelingsziektevirus wordt overgebracht door bladluizen, waarvan de groene perzikluis (*Myzus persicae*) de meeste efficiënte vector is. Er zijn drie soorten vergelingsziektevirussen: Beet Yellows Virus (BYV), Beet Chlorotic Virus (BChV) en Beet Mild Yellowing Virus (BMYV). De virussen kunnen worden beheerst door de bladluizen te bestrijden. Doel van dit onderzoek is de effectiviteit bepalen van verschillende soorten insecticiden voor de bestrijding van groene perzikluis om BMYV te beheersen. Omdat de zwarte bonenluis van nature ook voorkwam in de proef, is het effect op deze bladluissoort ook meegenomen in dit onderzoek. Er is een proefveld aangelegd in Westmaas waarbij groene perzikluizen, die vooraf geïnfecteerd waren met BMYV, op 14 mei 2020 (50 dagen na zaai) werden uitgezet. Dit is een veel hogere infectiedruk met virus dan de natuurlijke infectiedruk waarbij slechts maximaal 1% van de bladluizen besmet is. Vijf dagen na de inoculatie zijn de verschillende bespuitingen uitgevoerd.
Op basis van dit proefveld kunnen de volgende conclusies worden getrokken:

- IRS 800, Sumicidin Super en IRS 781 waren niet effectief in de beheersing van *Myzus persicae*, *Aphis fabae* en BMYV.
- Teppeki, IRS 770, IRS 810, Batavia, IRS 765, IRS 785 (alle doseringen) en IRS 811 waren effectief in de beheersing van *Myzus persicae* en BMYV hadden geen significant lagere opbrengst dan de niet-geïnoculeerde controle.
- Teppeki, IRS 810, IRS 765, IRS 785 (0.2 kg/ha) en IRS 785 (0.5 kg/ha) waren effectief in de beheersing van *Aphis fabae* (zes dagen na toepassing).

## Summary

Virus yellows is an important disease in sugar beet. Virus yellows is caused by the viruses Beet Yellows Virus (BYV), Beet Chlorotic Virus (BChV) en Beet Mild Yellowing Virus (BMYV), which can cause up to 50%, 30% and 35% yield reduction, respectively. In 2018 and 2019, in diagnostic samples from all over the Netherlands mainly BChV and BMYV were detected by IRS. These two viruses can be transmitted by different aphids. The green peach aphid (*Myzus persicae*) is the most important vector. Since the black bean aphid (*Aphis fabae*) was also present in the field trial, the effect on this aphid was investigated in this research as well.
Different insecticides were compared with a treatment without insecticide.
Therefore a field trial was conducted in Westmaas. In this trial green peach aphids, infected with BMYV, were inoculated in sugar beet in the 6-8 leaf stage (BBCH 12-18) at the 14$^{th}$ of May 2020 (50 days after sowing). This is a higher infection level in comparison with a natural situation. Normally, less than 1% of the green peach aphids is infected with virus, in the field trials it was 100%. Five days after inoculation, the plots were sprayed with the different treatment.
The aim was to study the efficacy of different insecticides on the control of BMYV, the green peach aphid (*Myzus persicae*) and the black bean aphid (*Aphis fabae*).
From this trial it can be concluded that:

- IRS 800, Sumicidin Super and IRS 781 were not effective in the control of *Myzus persicae*, *Aphis fabae* and BMYV.
- Teppeki, IRS 770, IRS 810, Batavia, IRS 765, IRS 785 (all dosages) and IRS 811 were all effective in the control of *Myzus persicae* and BMYV and did not show a significantly lower sugar yield than the non-inoculated control.
- Teppeki, IRS 810, IRS 765, IRS 785 (0.2 kg/ha) and IRS 785 (0.5 kg/ha) were effective in the control of *Aphis fabae* (six days after application).

# 1. Introduction

Virus yellows is an important disease in sugar beet. Virus yellows is caused by the viruses Beet Yellows Virus (BYV), Beet Chlorotic Virus (BChV) and Beet Mild Yellowing Virus (BMYV), which can cause up to 50%, 30% and 35% yield reduction, respectively. In 2018 and 2019, in diagnostic samples from all over the Netherlands mainly BChV and BMYV were detected by IRS. These two viruses can be transmitted by different aphids. The green peach aphid (*Myzus persicae*) is the most important vector. BChV and BMYV are transmitted persistently, meaning that once an aphid acquires the virus, it stays infectious for its whole life. The spread of the virus in a sugar beet field can be controlled by controlling aphids with insecticides. Also the black bean aphid (*Aphis fabae*) can cause problems in sugar beet. This aphid has a much higher damage threshold, since damage to sugar beets is mainly caused by feeding from the leaves and it hardly transmits viruses. Because this is a dominant species in sugar beet, it is also taken into account in this research.

The study was conducted under Good Experimental Practises (GEP, Annex A).

## 2. Materials and methods

### 2.1 Trial sites

The field trial was conducted in a sugar beet field in Westmaas, the Netherlands (Annex B).

### 2.2 List of products

Table 1 gives an overview of the treatments used in this study. Sugar beet seeds of the variety Caprianna KWS (8K815) were treated and delivered by KWS (Einbeck, D.). All seeds (also the untreated control) were treated with fungicides Vibrance SB (0.74 g fludioxonil, 0.5g sedaxane and 0.5g metalaxyl-m per 100.000 seeds) and Tachigaren (14.7 g hymexazol per 100.000 seeds) and the insecticide Force (10 g tefluthrin per 100.000 seeds) to prevent influences of fungi and soil pests on plant establishment. Tefluthrin does not have any effect on green peach or black bean aphids.

**Table 1.** Overview of treatments in the field trial in Westmaas, 2020 (trial code: 20-11-02.01). Times of application can be found in table 2.

| *number* | *treatment* | *rate* |
|---|---|---|
| 1 | not inoculated | * |
| 2 | untreated control | - |
| 3 | Teppeki (flonicamid) | 0.14 kg/ha |
| 4 | IRS 770 | 0.25 l/ha |
| 5 | IRS 810 | 0.2 l/ha |
| 6 | Batavia (spirotetramat) | 0.45 l/ha |
| 7 | IRS 765 | 0.1 l/ha |
| 8 | IRS 785 | 0.25 kg/ha |
| 9 | IRS 785 | 0.20 kg/ha |
| 10 | IRS 785 | 0.125 kg/ha |
| 11 | IRS 785 | 0.5 kg/ha |
| 12 | IRS 811 | 0.25 kg/ha |
| 13 | IRS 800 + 0.25% Addit (adjuvant) | 3.0 kg/ha |
| 14 | Sumicidin Super (esfenvalerate) | 0.2 l/ha |
| 15 | IRS 781 | 0.12% |

*this treatment was sprayed with Teppeki (0.14 kg/ha) to prevent damage by naturally occurring aphids on the 19th of May, 2020.

### 2.3 Drilling

Drilling was done with a precision sowing machine (Monosem Mecca 2000) adapted for sowing of field trials. Sowing distance within the rows was 18.0 cm and 50 cm between rows. The field trial was sown on 25 March, 2020. The trial was designed as randomised blocks in four replications (Annex C). Gross plot size: 3 meters wide (6 rows) and 15.5 meters long. Nett plot size: 3 meters wide (6 rows) and 12 meters long. To prevent spread of aphids and virus to neighbouring plots, six rows of sugar beet were sown between the treated plots, which were sprayed with Teppeki (flonicamid; 0.14 kg/ha) one day before inoculation with green peach aphids. General field data can be found in Annex D.

## 2.4 Inoculation with aphids

Prior to inoculation, number of natural occurring aphids were counted in plots of treatments 1, 2, 3 and 8 to 12 on twelve plants per plot (plant numbers 5, 10, 15, 20, 25 and 30 starting at the beginning of row 2 and at the end of row 5) on the 13th of May, 2020 (BBCH 12-18) (Annex E). To obtain a homogenous distribution of virus yellows, the trial was inoculated with reared green peach aphids.
In September 2019, sugar beets with Beet Mild Yellowing Virus (BMYV) were collected from a sugar beet field in Rilland (Netherlands; IRS diagnostic sample 19-526). These sugar beets were potted in a mixture of 50% sand (sand from the river Maas; Vriends de Schelde BV, Bergen op Zoom, NL) and 50% potting soil (Primasta Flower Power, Primasta BV, Asten, NL) (v/v), watered and placed in the climate chambers at IRS (Dinteloord). Climate room conditions were 23 °C for 16 h in light (LED 119 mmol/$m^2$/s, RAZRx PLUS, Fluence Bioengineering, Austin, Texas, USA) and 16 °C for 8 h in dark. Virus free green peach aphids (originally obtained from the Laboratory of Entomology of Wageningen University and Research (Wageningen, the Netherlands) in 2018) were transferred to the leaves of the infected sugar beets. After 48 hours these aphids were collected and transferred to six week old sugar beet plants (grown in 700 ml pots with the same mixture as described above; variety Kleist, Strube GmbH, Söllingen, Germany) in the climate chambers and placed in an aphid rearing cage. Every three to four weeks, leaves with aphids were cut off and transferred to new, six weeks old plants to maintain the culture of green peach aphids (and BMYV) in the climate chambers. This resulted in an 100% infected aphid population for inoculation in the field.
The field trial was inoculated with the reared green peach aphids carrying BMYV on 14$^{th}$ of May, 2020 (50 days after sowing; BBCH 12-18). For field inoculation, leaves with aphids from the plants in aphid rearing cages in the climate chambers were cut off and carefully transported to the field trials in small boxes. Three plants in row 2 and three plants in row 5 of each plot were inoculated with ten aphids per plant, by transferring the aphids using a small paint brush. Plant numbers 5, 15 and 25, counting from the beginning of row 2 and from the end of row 5, were inoculated.
One day before inoculation (13$^{th}$ of May) the field (except for the trial plots) was sprayed with Teppeki (0,14 kg/ha) to prevent spread of aphids over the field.

## 2.5 Application of treatments

Treatment 2 was the untreated control. Treatments 1 and 3 to 14 were sprayed on the 19$^{th}$ of May, 2020, five days post inoculation. Insecticides were applied with a broadcast application, where the entire area of each plot was treated. Applications of these treatments were conducted by Wageningen Plant Research (WPR; location Westmaas), using a CHD field trial sprayer (system Van der Wey, with Lechler Nozzle 120-02 at 3.0 bar and 400 liter spraying solution per hectare) to apply the different treatments. These nozzles had a 75% drift reduction at the pressure used (TCT, 2019).
Treatment 13 was also sprayed on the 12$^{th}$ and 29$^{th}$ of May and the 4$^{th}$ of June. Treatment 15 had to be sprayed during the day under dry conditions and was therefore sprayed separately with the hand sprayer (with Nozzle TeeJet XR 11003 at 3.0 bar and 400 liter spraying solution per hectare) on the 19$^{th}$ of May by Wageningen Plant Research. These nozzles also had a 75% drift reduction at the pressure used (TCT, 2019).

**Table 2.** Conditions during spraying at the field trial in Westmaas, 2020.

| *parameter* | *treatment 13 (12 May)* | *treatment 1 and 3-14 (19 May)* | *treatment 15 (19 May)* | *treatment 13 (29 May)* | *treatment 13 (4 June)* |
|---|---|---|---|---|---|
| application time | 14.00 h. | 7.30 h. | 14.00 h. | 8.45 h. | 9.00 h. |
| application duration (minutes) | 10 | 30 | 10 | 10 | 10 |
| temperature (°C) | 20 | 15 | 20 | 13 | 14 |
| relative humidity (RV) | 44 | 70 | 65 | 70 | 78 |
| wind speed | 2 km/h | 6 km/h | 9 km/h | 7 km/h | 9 km/h |
| wind direction | North West | West | West | North East | North West |

## 2.6 Assessment of efficacy

The effect of the different treatments on inoculated green peach aphids and natural occurring black bean aphids was measured by counting the number of aphids in all plots on twelve plants per plot (plant numbers 5, 10, 15, 20, 25 and 30 starting at the beginning of row 2 and at the end of row 5 1 day after application (20$^{th}$ of May), 6-7 days after application (25$^{th}$ and 26$^{th}$ of May), 14-15 days after application (2$^{nd}$ and 3$^{rd}$ of June) and 22-23 days after application (10$^{th}$ and 11$^{th}$ of June). On the same plants, the number of other aphids and the number of beneficials (e.g. eggs, larvae and adults of ladybird beetles, soldier beetles, spiders, parasitic wasps, hoverflies, lacewings) was counted as well (data only shown in Annexes). The effect on BMYV was measured by counting the number of plants with yellowing symptoms per plot 7 (6$^{th}$ of July), 12 (11$^{th}$ of August) and 17 weeks (11$^{th}$ of September) after inoculation.

## 2.7 Aphid destruction

After the assessment on the effect on the number of aphids, the whole field (including the trial plots) was sprayed with Batavia SC (spirotetramat; 0,45 L/ha; 23$^{rd}$ of June, 2020) to control the aphids and to prevent that aphids and viruses were spread to the neighbouring farmer fields.

## 2.8 Yield assessment

The field trial was harvested on 18$^{th}$ of September, 2020 with the six row sugar beet harvester of IRS (PASSI), which is adapted to harvest field trials. From each plot the gross weight of the plot was measured by this harvester and of each plot a subsample of 60-80 kilogram was taken to the tare house of Cosun Beet Company (Dinteloord, NL) for analysis of sugar beet quality. In the tare house, the subsample was divided into two samples, in which soil tare, sugar-, potassium-, sodium-, amino nitrogen content and content of glucose was determined. Nett weight was calculated by subtracting soil tare from gross weight. Based on the quality assessments and nett weight, sugar yield and financial yield were calculated, based on 35 €/ton sugar beets with 17% sugar, taking quality (WIN) and soil tare into account. Financial yield in this report is presented as gross financial yield. Costs of spraying and crop protection products are not taken into account.

## 2.9 Analysis of data

Since data of aphid counts were non-normal distributed, these data were log transformed before statistical analysis.
From the treatments 1 and 3 to 12 also the efficiency of the insecticides with a correction for natural death was calculated according to Abbott's formula: Percentage mortality = (1-(n in

treatment/n in untreated control))*100. This was not done for the treatments 13 to 15, since they were not effective in the control of aphids and Abbott assumes that an insecticide is efficient in its analysis. Data were analysed by ANOVA using Fisher Protected LSD. Analyses were done with Genstat Software Package 19.0.

# 3. Results and discussion

## 3.1 Effect on aphids

Percentage mortality by Abbott's formula were not calculated for the treatments 13 to 15, since they were not effective in the control of aphids and Abbott assumes that an insecticide is efficient in its analysis. Data are shown in this report, but results are discussed based on number of aphids.

### 3.1.1 Effect on green peach aphid (*Myzus persicae)*

There was no significant difference in the number of natural occurring green peach aphids at the 13th of May before application of the treatments (P = 0.776) (table 3; Annex E) between the treatments.
One day after treatment (20 May), IRS 785 (0.2 kg/ha) had significantly the lowest numbers of *Myzus persicae*, although this was not significantly different from the not inoculated control, IRS 770, Batavia, IRS 811 and all other dosages of IRS 785. Only IRS 785 (0.2 kg/ha) had significantly lower numbers of *Myzus persicae* than the untreated control.
Six days after treatment (25 May), IRS 785 (0.2 kg/ha) still had the lowest numbers of *Myzus persicae*, although this was not significantly different from IRS 810, IRS 765, IRS 811, IRS 785 (0.25 kg/ha) and IRS 785 (0.5 kg/ha). IRS 765, IRS 785 (0.25 kg/ha) and IRS 785 (0.2 kg/ha) had significantly less green peach aphids than the positive control (Teppeki). All treatments, except for IRS 800, Sumicidin Super and IRS 781 were significantly more effective than the untreated control. IRS 800, Sumicidin super and IRS 781 are all contact insecticides and with the current spraying techniques it is very hard or even impossible to reach the green peach aphids, which are present at the underside of the leaves and curly leaf edges.
Fourteen days after treatment (2 June), the uninoculated control, IRS 765, IRS 785 (0.25 kg/ha), IRS 785 (0.20 kg/ha), IRS 785 (0.5 kg/ha) and IRS 811 had significantly less green peach aphids compared to the untreated control.
22 Days after treatment (10 June) IRS 785 (0.125 kg/ha) and IRS 810 had significantly less green peach aphids than the untreated control. Although it was significant, it is remarkable that the lowest dosage of IRS 785, which performed less compared to the other dosages of IRS 785, had the lowest number of  effect on the green peach aphids.

**Table 3.** Number of green peach aphids (*Myzus persicae*) per twelve plants at the field trial in Westmaas (2020). Treatments were applied on the 19th of May (except for IRS 800 + 0.25% Addit, which was applied on the 12th of May for the first time).

| | *treatment* | *Number of green peach aphids* (Myzus persicae) *per 12 plants* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 13 May | 20 May | | 25 May | | 2 June | | 10 June | |
| 1 | not inoculated | 48.7 | 91.9 | abcde | 10.1 | b | 10.3 | d | 5.0 | bcde |
| 2 | untreated control | 99.2 | 105.9 | abcd | 80.5 | a | 37.1 | abc | 16.2 | bcd |
| 3 | Teppeki | 77.7 | 138.0 | abc | 11.2 | b | 14.3 | cd | 5.1 | bcde |
| 4 | IRS 770 | - | 89.4 | abcde | 8.1 | bc | 18.8 | bcd | 4.6 | cde |
| 5 | IRS 810 | - | 108.1 | abcd | 2.6 | bcd | 15.6 | bcd | 2.8 | e |
| 6 | Batavia | - | 91.5 | abcde | 11.1 | b | 15.6 | bcd | 4.0 | de |
| 7 | IRS 765 | - | 174.0 | ab | 1.8 | cd | 10.5 | d | 3.2 | de |
| 8 | IRS 785 (0.25 kg/ha) | 54.1 | 61.7 | cde | 1.9 | cd | 10.7 | d | 5.0 | bcde |
| 9 | IRS 785 (0.2 kg/ha) | 93.0 | 40.3 | e | 0.8 | d | 8.9 | d | 6.1 | bcde |
| 10 | IRS 785 (0.125 kg/ha) | 78.1 | 84.3 | bcde | 6.5 | bc | 16.5 | bcd | 1.1 | e |
| 11 | IRS 785 (0.5 kg/ha) | 98.3 | 48.9 | de | 4.4 | bcd | 6.6 | d | 5.0 | cde |
| 12 | IRS 811 | 53.3 | 61.8 | cde | 4.2 | bcd | 7.9 | d | 6.0 | bcde |
| 13 | IRS 800 + 0.25% Addit | - | 214.3 | a | 134.8 | a | 89.6 | a | 20.5 | ab |
| 14 | Sumicidin Super | - | 211.8 | a | 134.8 | a | 76.8 | a | 25.0 | a |
| 15 | IRS 781 | - | 161.6 | ab | 63.6 | a | 45.6 | ab | 16.9 | abc |
| P | | 0.776 | 0.009 | | <0.001 | | <0.001 | | <0.001 | |
| Significance | | not significant | significant | | very significant | | very significant | | very significant | |

* Virus infected *Myzus persicae* was inoculated on 14th of May.

**Table 4.** Insecticide efficiency (calculated with Abbott's formula) of the different treatments on the control of green peach aphids (*Myzus persicae*) compared to the untreated control at the field trial in Westmaas (2020). Treatments were applied on the 19th of May (except for IRS 800 + 0.25% Addit, which was applied on the 12th of May for the first time).

| | *treatment* | *Percentage mortality compared to untreated control* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 20 May | 25 May | | 2 June | | 10 June | |
| 1 | not inoculated | 28.7 | 74.3 | ab | 63.8 | | 55.9 | b |
| 2 | untreated control | 0.0 | 0.0 | c | 0.0 | | 0.0 | c |
| 3 | Teppeki | 12.2 | 73.1 | ab | 59.1 | | 57.6 | ab |
| 4 | IRS 770 | 28.1 | 84.2 | a | 46.4 | | 61.6 | ab |
| 5 | IRS 810 | 16.8 | 88.1 | a | 50.2 | | 64.8 | ab |
| 6 | Batavia | 21.6 | 55.1 | b | 45.1 | | 67.3 | ab |
| 7 | IRS 765 | 0.0 | 96.5 | a | 52.9 | | 58.2 | ab |
| 8 | IRS 785 (0.25 kg/ha) | 41.1 | 96.9 | a | 61.6 | | 59.4 | ab |
| 9 | IRS 785 (0.20 kg/ha) | 53.8 | 97.4 | a | 68.1 | | 53.8 | b |
| 10 | IRS 785 (0.125 kg/ha) | 34.7 | 86.9 | a | 48.0 | | 92.0 | a |
| 11 | IRS 785 (0.5 kg/ha) | 46.2 | 85.0 | a | 57.1 | | 55.5 | b |
| 12 | IRS 811 | 38.7 | 94.2 | a | 66.1 | | 53.2 | b |
| 13 | IRS 800 + 0.25% Addit | - | - | | - | | - | |
| 14 | Sumicidin Super | - | - | | - | | - | |
| 15 | IRS 781 | - | - | | - | | - | |
| P | | 0.100 | <0.001 | | 0.074 | | 0.013 | |
| Significance | | not significant | very significant | | not significant | | significant | |

### 3.1.2 Effect on black bean aphid (*Aphis fabae)*

There was no significant difference between the treatments in the number of natural occurring green peach aphids at 13 May before application of the treatments (P = 0.118) and one day after application (20 May) (table 5; Annex F).
Six days after treatment (25 May), IRS 810 (0.2 kg/ha) had the lowest numbers of *Aphis fabae*, although this was not significantly different from Teppeki, IRS 770, Batavia, IRS 765, IRS 785 (all dosages) and IRS 811. Only Teppeki, IRS 810, IRS 765, IRS 785 (0.2 kg/ha) and IRS 785 (0.5 kg/ha) had a significantly lower number of *Aphis fabae* than the untreated control. Sumicidin Super had the highest number of *Aphis fabae*, although this was not significantly different from the untreated control and IRS 800.
Fourteen days after treatment (2 June), Batavia had the lowest numbers of *Aphis fabae*, but this was not significantly different with IRS 765, IRS 785 (0.2 kg/ha). Treatments with Batavia, IRS 765 and IRS 785 (0.2 kg/ha) resulted in significantly less *Aphis fabae* compared to the untreated control.
22 Days after treatment (10 June), Teppeki, Batavia and IRS 785 (0.2 kg/ha) had significantly less *Aphis fabae* than the untreated control.

**Table 5.** Number of black bean aphids (*Aphis fabae*) per twelve plants at the field trial in Westmaas (2020). Treatments were applied on the 19th of May (except for IRS 800 + 0.25% Addit, which was applied on the 12th of May for the first time).

| | *treatment* | *Number of black bean aphids* (Aphis fabae) *per 12 plants* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | | 2 June | | 10 June | |
| 1 | not inoculated | 275.1 | 229.7 | 8.7 | bc | 8.2 | bcd | 20.9 | bc |
| 2 | untreated control | 224.4 | 107.4 | 48.0 | ab | 38.5 | bc | 69.5 | ab |
| 3 | Teppeki | 102.5 | 170.0 | 4.3 | c | 7.4 | bcd | 6.6 | c |
| 4 | IRS 770 | | 69.3 | 7.9 | bc | 16.6 | bcd | 14.0 | bc |
| 5 | IRS 810 | | 300.3 | 3.4 | c | 12.5 | bcd | 14.9 | bc |
| 6 | Batavia | | 266.3 | 10.9 | bc | 3.1 | d | 5.4 | c |
| 7 | IRS 765 | | 242.2 | 3.9 | c | 4.1 | d | 12.0 | bc |
| 8 | IRS 785 (0.25 kg/ha) | 99.5 | 91.7 | 4.9 | bc | 12.8 | bcd | 18.6 | bc |
| 9 | IRS 785 (0.20 kg/ha) | 68.3 | 22.8 | 1.4 | c | 4.5 | d | 7.7 | c |
| 10 | IRS 785 (0.125 kg/ha) | 102.0 | 92.5 | 12.7 | bc | 6.7 | bcd | 11.3 | bc |
| 11 | IRS 785 (0.5 kg/ha) | 164.6 | 99.0 | 2.4 | c | 6.3 | cd | 35.2 | bc |
| 12 | IRS 811 | 124.3 | 96.1 | 10.5 | bc | 10.4 | bcd | 24.1 | bc |
| 13 | IRS 800 + 0,25% Addit | | 337.1 | 189.1 | a | 51.8 | ab | 20.2 | bc |
| 14 | Sumicidin Super | | 294.8 | 246.2 | a | 303.1 | a | 284.1 | a |
| 15 | IRS 781 | | 77.9 | 15.6 | bc | 37.5 | bc | 41.4 | abc |
| P | | 0.118 | 0.089 | 0.001 | | 0.005 | | 0.048 | |
| Significance | | not significant | not significant | significant | | significant | | significant | |

**Table 6.** Insecticide efficiency (calculated with Abbott's formula) of the different treatments on the control of black bean aphids (*Aphis fabae*) compared to the untreated control at the field trial in Westmaas (2020). Treatments were applied on the 19th of May (except for IRS 800 + 0.25% Addit, which was applied on the 12th of May for the first time).

| | *treatment* | *Percentage mortality compared to untreated control* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 20 May | 25 May | | 2 June | | 10 June | |
| 1 | not inoculated | 24.5 | 59.0 | abc | 72.5 | a | 57.3 | ab |
| 2 | untreated control | 0.0 | 0.0 | d | 0.0 | b | 0.0 | c |
| 3 | Teppeki | 18.1 | 73.5 | abc | 61.6 | a | 70.0 | ab |
| 4 | IRS 770 | 45.9 | 59.9 | abc | 46.4 | a | 66.9 | ab |
| 5 | IRS 810 | 23.3 | 59.9 | abc | 51.8 | a | 63.8 | ab |
| 6 | Batavia | 14.8 | 68.4 | abc | 71.4 | a | 83.1 | a |
| 7 | IRS 765 | 22.2 | 60.3 | abc | 69.3 | a | 67.0 | ab |
| 8 | IRS 785 (0.25 kg/ha) | 22.9 | 76.9 | abc | 47.2 | a | 65.3 | ab |
| 9 | IRS 785 (0.20 kg/ha) | 62.8 | 98.0 | a | 65.4 | a | 86.5 | a |
| 10 | IRS 785 (0.125 kg/ha) | 36.9 | 47.9 | c | 53.7 | a | 47.4 | ab |
| 11 | IRS 785 (0.5 kg/ha) | 38.9 | 91.5 | ab | 67.0 | a | 40.8 | b |
| 12 | IRS 811 | 36.2 | 53.3 | bc | 59.8 | a | 46.2 | ab |
| 13 | IRS 800 + 0.25% Addit | - | - | | - | | - | |
| 14 | Sumicidin Super | - | - | | - | | - | |
| 15 | IRS 781 | - | - | | - | | - | |
| P | | 0.127 | 0.005 | | 0.036 | | 0.016 | |
| Significance | | not significant | significant | | significant | | significant | |

### 3.2 Effect on Beet Mild Yellowing Virus (BMYV)

The effect of the treatments on the symptoms of BMYV was measured on the 6th of July, 11th of August and 11th of September, 2020.

On all assessment dates, there was only a very low number of plants with virus yellows symptoms in the non-inoculated control (treatment 1; table 7, Annex I).

On the 6th of July, Sumicidin Super had the highest percentage of plants with symptoms of virus yellows. However, this was not significantly different from the percentage of plants with symptoms of virus yellows in the untreated control, IRS 800 and IRS 781. Teppeki, IRS 810, IRS 765, IRS 785 (all dosages) and IRS 811 had significantly less plants with virus yellows than the untreated control, although this was not significantly different from IRS 770 and Batavia. Effect on BMYV corresponds well with the effect on *Myzus persicae*.
On the 11th of August and the 11th of September, treatments 3 to 12 all had a significantly lower percentage of plants with symptoms of virus yellows than the untreated control. None of the treatments 4 to 12 were significantly different from Teppeki. IRS 800, Sumicidin Super and IRS 781 were on both assessment dates not significantly better than the untreated control.

**Table 7.** Percentage of plants with symptoms of virus yellows at the field trial in Westmaas (2020).

| | *treatment* | *Percentage of plants with symptoms of virus yellows* | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 July | | 11 August | | 11 September | |
| 1 | not inoculated | 0.1 | d | 0.3 | d | 0.8 | d |
| 2 | untreated control | 10.0 | ab | 15.3 | a | 22.6 | ab |
| 3 | Teppeki | 5.2 | c | 6.9 | bc | 9.8 | c |
| 4 | IRS 770 | 6.0 | bc | 6.3 | bc | 13.2 | c |
| 5 | IRS 810 | 4.9 | c | 5.2 | bc | 11.8 | c |
| 6 | Batavia | 5.8 | bc | 8.1 | b | 14.2 | bc |
| 7 | IRS 765 | 3.4 | c | 5.2 | bc | 8.8 | c |
| 8 | IRS 785 (0.25 kg/ha) | 4.1 | c | 7.8 | bc | 13.0 | c |
| 9 | IRS 785 (0.20 kg/ha) | 4.4 | c | 6.1 | bc | 11.1 | c |
| 10 | IRS 785 (0.125 kg/ha) | 4.5 | c | 4.5 | c | 9.9 | c |
| 11 | IRS 785 (0.5 kg/ha) | 5.3 | c | 6.7 | bc | 10.7 | c |
| 12 | IRS 811 | 4.1 | c | 7.4 | bc | 11.3 | c |
| 13 | IRS 800 + 0.25% Addit | 10.9 | a | 19.3 | a | 26.2 | a |
| 14 | Sumicidin Super | 12.9 | a | 16.8 | a | 26.4 | a |
| 15 | IRS 781 | 12.8 | a | 19.7 | a | 28.0 | a |
| P | | <0.001 | | <0.001 | | <0.001 | |
| Significance | | very significant | | very significant | | very significant | |

### 3.3 Effect on phytotoxicity

No symptoms of phytotoxicity were observed in any of the treatments at any date (Annex J).

### 3.4 Effect on yield

At Westmaas, there was a significant effect of treatment on sugar weight, sugar content and financial yield (Table 8; Annex L). This was as expected, since it is known that virus yellows, can reduce sugar yield.
Sugar beets treated with IRS 800 and Sumicidin Super had a significantly lower percentage of sugar than the untreated control. There was no significant difference between the untreated control and the other treatments.
IRS 785 (0.125 kg/ha) had the highest sugar yield, although this was not significantly different from the uninoculated control, Teppeki, IRS 770, IRS 810, Batavia, IRS 765, all other dosages of IRS 785 and IRS 811. Only IRS 785 (0.125 kg/ha) and the uninoculated control had a significantly higher sugar weight than the untreated control.

**Table 8.** Root weight (ton/ha), sugar percentage, sugar weight (ton/ha) and financial yield (€/ha) for each treatment at the field trial in Westmaas (18th of September, 2020).

| | *treatment* | *root weight (t/ha)* | *sugar content (%)* | | *sugar weight (t/ha)* | | *financial yield (€/ha)* | |
|---|---|---|---|---|---|---|---|---|
| 1 | not inoculated | 121.7 | 16.24 | a | 19.8 | a | 3922 | ab |
| 2 | untreated control | 112.8 | 15.98 | ab | 18.0 | bcde | 3534 | bcde |
| 3 | Teppeki | 117.7 | 16.13 | ab | 19.0 | abc | 3759 | abc |
| 4 | IRS 770 | 118.7 | 16.07 | ab | 19.1 | abc | 3754 | abc |
| 5 | IRS 810 | 120.6 | 16.28 | a | 19.7 | ab | 3913 | ab |
| 6 | Batavia | 114.0 | 16.24 | a | 18.5 | abcd | 3678 | abcd |
| 7 | IRS 765 | 117.1 | 16.30 | a | 19.1 | abc | 3804 | ab |
| 8 | IRS 785 (0.25 kg/ha) | 117.5 | 16.20 | a | 19.0 | abc | 3763 | abc |
| 9 | IRS 785 (0.20 kg/ha) | 116.8 | 16.17 | ab | 18.9 | abcd | 3751 | abc |
| 10 | IRS 785 (0.125 kg/ha) | 122.8 | 16.41 | a | 20.2 | a | 4045 | a |
| 11 | IRS 785 (0.5 kg/ha) | 117.0 | 16.03 | ab | 18.8 | abcd | 3698 | abc |
| 12 | IRS 811 | 116.9 | 16.18 | a | 18.9 | abcd | 3727 | abc |
| 13 | IRS 800 + 0.25% Addit | 111.1 | 15.53 | c | 17.3 | de | 3292 | de |
| 14 | Sumicidin Super | 107.0 | 15.48 | c | 16.6 | e | 3148 | e |
| 15 | IRS 781 | 112.3 | 15.74 | bc | 17.7 | cde | 3399 | cde |
| P | | 0.067 | 0.001 | | 0.010 | | 0.003 | |
| LSD 5% | | - | 0.434 | | 1.72 | | 395.9 | |
| Significance | | not significant | significant | | significant | | significant | |

## 4. Conclusions

The aim was to study the efficacy of different insecticides on the control of Beet Mild Yellowing Virus (BMYV), the green peach aphid (*Myzus persicae*) and the black bean aphid (*Aphis fabae*). From this trial it can be concluded that:

- IRS 800, Sumicidin Super and IRS 781 were not effective in the control of *Myzus persicae*, *Aphis fabae* and BMYV.
- Teppeki, IRS 770, IRS 810, Batavia, IRS 765, IRS 785 (all dosages) and IRS 811 were all effective in the control of *Myzus persicae* and BMYV and did not show a significantly lower sugar yield than the non-inoculated control.
- Teppeki, IRS 810, IRS 765, IRS 785 (0.2 kg/ha) and IRS 785 (0.5 kg/ha) were effective in the control of *Aphis fabae* (six days after application).

## 5. Literature

Raaijmakers, E. (2020). Research on the efficacy of different insecticides to control the green peach aphid (*Myzus persicae*), the black bean aphid (*Aphis fabae*) and Beet Chlorosis Virus (BChV) in the Netherlands in 2019. IRS, Dinteloord, pp 42.

Technische Commissie Techniekbeoordeling (2019). Lijst met indeling van spuitdoppen in DriftReducerende Dop-klassen (DRD-klassen). Versie 1 juli 2019. https://www.sklkeuring.nl/media/files/DRD%20Lijst%201%20juli%202019.pdf.

# Annex A GEP CERTIFICATE IRS

Netherlands Food and Consumer
Product Safety Authority
*Ministry of Economic Affairs*

## *Certificate*

of Official Recognition of Efficacy Testing Organisations in the Netherlands
This certifies that, in conformity with the request of March 26, 2014

**STICHTING IRS**

Residing: Van Konijnenburgweg 24, Bergen op Zoom, the Netherlands

has officially been recognised as an organisation for efficacy testing in the Netherlands.

As has been laid down in the 'Regeling gewasbeschermingsmiddelen en biociden' (Regulation Crop Protection Products and Biocides) of September 26, 2007 (Staatscourant 2007, 386).

This recognition commences on: June 19, 2014
and expires on: June 19, 2020

The above organisation is competent to carry out efficacy trials/tests in the categories mentioned in the annex of this certificate.

Utrecht, August 18, 2014

For the Minister of Economic Affairs,

H.A. Harmsma LL M, Bsc

Chief Inspector of the Netherlands Food and Consumer Product Safety Authority

**CERTIFICATE NUMBER: NL_GEP_04149620**

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**Annex**

Stichting IRS is officially recognised as being competent to carry out efficacy trials/tests in the following categories:

- Outdoor crops of sugar beet and cichory

This annex has been approved by H.A. Harmsma LL M, Bsc

Chief Inspector of the Food and Consumer Product Safety Authority

Due to COVID-19 pandemic, the recognition of efficacy testing could not be renewed before June 19, 2020. Therefore, a temporary certificate was issued.

Netherlands Food and Consumer Product Safety Authority
*Ministry of Agriculture, Nature and Food Quality*

# *Certificate*

of Official Recognition of Efficacy Testing Organisations in the Netherlands
This certifies that, in conformity with the request of March 26, 2014

**STICHTING IRS**

Residing: Kreekweg 1, Dinteloord, the Netherlands

has officially been recognised as an organisation for efficacy testing in the Netherlands.

As has been laid down in the 'Regeling gewasbeschermingsmiddelen en biociden' (Regulation Crop Protection Products and Biocides) of September 26, 2007 (Staatscourant 2007, 386).

This recognition commences on: June 19, 2020
and expires on: December 19,2020

The above organisation is competent to carry out efficacy trials/tests in the categories mentioned in the annex of this certificate.

Utrecht, May 19, 2020

For the Minister of Agriculture, Nature and Food Quality,

Ton van Arnhem

*Director NPPO (National Plant Protection Organization)*

**CERTIFICATE NUMBER: NL_GEP_04200620**

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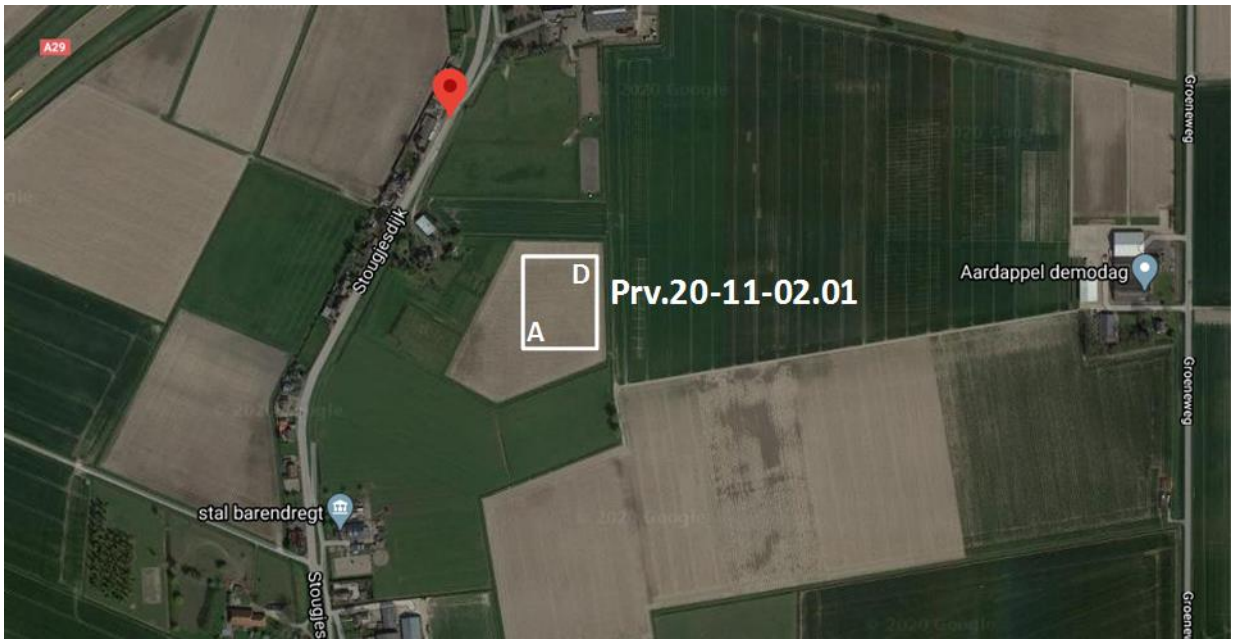
# Annex B Location field trial

IRS trial field 20-11-02.01
GPS location:
51.7892716, 4.4315667



## Annex C Trail scheme

| | | | |
|---|---|---|---|
| Trial field: | Westmaas | | |
| Number of replications: | 4 | | |
| Nett size (m): | 12×3 | Gross size (m): | 15.5×3 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **C** | | | | | | | | | | | **D** | | | | | | | | |
| **15** | | **3** | | **11** | | **14** | | **6** | | | **13** | | **4** | | **8** | | **10** | | **5** |
| **9** | | **1** | | **4** | | **13** | | **12** | | | **14** | | **15** | | **2** | | **11** | | **7** |
| **8** | **tramline (9m)** | **5** | **gross (3m)** | **2** | **gross (3m)** | **7** | **tramline (9m)** | **10** | **gross (3m)** | | **1** | **gross (3m)** | **6** | **tramline (9m)** | **3** | **gross (3m)** | **9** | **gross (3m)** | **12** |
| **7** | | **13** | | **10** | | **3** | | **4** | | | **12** | | **5** | | **15** | | **1** | | **8** |
| **12** | | **14** | | **15** | | **1** | | **9** | | | **7** | | **11** | | **6** | | **2** | | **13** |
| **5** | | **8** | | **6** | | **2** | | **11** | | | **10** | | **14** | | **9** | | **4** | | **3** |
| **A** | | | | | | | | | | | **B** | | | | | | | | |

## Annex D General field data

| | |
|---|---|
| soil type: | marine soil (clay loam)<br>2.6% organic matter<br>pH-KCl = 7.3<br>%$CaCO_3$ = 5.7<br>% silt: 24<br>% lutum: 15<br>K-value = 19 |
| preceding crop: | 2019 winter wheat followed by green manure crop<br>2018 potatoes<br>2017 grass seeds<br>2016 grass seeds<br>2015 winter barley<br>2014 winter wheat |
| drilling date: | 25 March 2020 |
| variety: | Caprianna KWS (KWS, Einbeck, Germany) |
| distance in row: | 18.0 cm |
| distance between rows: | 50 cm |

## Annex E Raw data *Myzus persicae*

**Table E.1.** Number of green peach aphids (*Myzus persicae*) per 12 plants at the field trial in Westmaas (2020).

| *treatment* | *replicate* | *Number of* Myzus persicae *per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 1 | A | 25 | 32 | 23 | 5 | 10 |
| 1 | B | 7 | 35 | 8 | 6 | 2 |
| 1 | C | 145 | 343 | 4 | 12 | 7 |
| 1 | D | 200 | 182 | 13 | 29 | 4 |
| 2 | A | 45 | 199 | 85 | 35 | 37 |
| 2 | B | 94 | 18 | 43 | 29 | 5 |
| 2 | C | 186 | 496 | 483 | 121 | 75 |
| 2 | D | 122 | 68 | 23 | 15 | 4 |
| 3 | A | 203 | 273 | 26 | 13 | 3 |
| 3 | B | 2 | 73 | 14 | 15 | 3 |
| 3 | C | 239 | 254 | 4 | 26 | 20 |
| 3 | D | 260 | 71 | 10 | 8 | 3 |
| 4 | A | * | 179 | 13 | 6 | 5 |
| 4 | B | * | 73 | 5 | 22 | 1 |
| 4 | C | * | 90 | 8 | 26 | 15 |
| 4 | D | * | 54 | 8 | 34 | 4 |
| 5 | A | * | 179 | 3 | 10 | 1 |
| 5 | B | * | 29 | 0 | 15 | 4 |
| 5 | C | * | 213 | 3 | 23 | 6 |
| 5 | D | * | 122 | 10 | 17 | 2 |
| 6 | A | * | 171 | 66 | 33 | 4 |
| 6 | B | * | 7 | 0 | 3 | 0 |
| 6 | C | * | 440 | 10 | 18 | 15 |
| 6 | D | * | 119 | 28 | 28 | 7 |
| 7 | A | * | 272 | 4 | 20 | 3 |
| 7 | B | * | 40 | 0 | 10 | 4 |
| 7 | C | * | 535 | 3 | 4 | 3 |
| 7 | D | * | 155 | 2 | 14 | 3 |
| 8 | A | 38 | 124 | 2 | 11 | 7 |
| 8 | B | 9 | 25 | 0 | 12 | 4 |
| 8 | C | 117 | 196 | 7 | 9 | 10 |
| 8 | D | 199 | 23 | 2 | 11 | 2 |
| 9 | A | 59 | 51 | 1 | 5 | 7 |
| 9 | B | 49 | 18 | 4 | 22 | 7 |
| 9 | C | 169 | 112 | 0 | 13 | 12 |
| 9 | D | 152 | 25 | 0 | 4 | 2 |
| 10 | A | 131 | 142 | 24 | 25 | 4 |
| 10 | B | 15 | 53 | 8 | 7 | 1 |
| 10 | C | 192 | 184 | 6 | 15 | 1 |
| 10 | D | 95 | 36 | 1 | 27 | 0 |

| *treatment* | *replicate* | *Number of* Myzus persicae *per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 11 | A | 116 | 126 | 13 | 0 | 5 |
| 11 | B | 21 | 20 | 19 | 43 | 5 |
| 11 | C | 173 | 105 | 2 | 6 | 11 |
| 11 | D | 217 | 21 | 0 | 10 | 2 |
| 12 | A | 130 | 256 | 5 | 5 | 12 |
| 12 | B | 3 | 33 | 3 | 6 | 2 |
| 12 | C | 151 | 136 | 9 | 9 | 11 |
| 12 | D | 108 | 12 | 2 | 14 | 4 |
| 13 | A | * | 485 | 406 | 73 | 38 |
| 13 | B | * | 46 | 47 | 65 | 4 |
| 13 | C | * | 354 | 99 | 50 | 10 |
| 13 | D | * | 264 | 173 | 270 | 99 |
| 14 | A | * | 272 | 374 | 90 | 41 |
| 14 | B | * | 129 | 50 | 71 | 7 |
| 14 | C | * | 471 | 101 | 154 | 84 |
| 14 | D | * | 121 | 173 | 35 | 15 |
| 15 | A | * | 212 | 151 | 113 | 64 |
| 15 | B | * | 164 | 30 | 22 | 5 |
| 15 | C | * | 340 | 64 | 71 | 37 |
| 15 | D | * | 57 | 56 | 24 | 6 |

*These plots were not counted on the 13th of May.

**Table E.2.** Mortality (%) of green peach aphids (*Myzus persicae*) according to Abbott's formula at the field trial in Westmaas (2020). When a specific plot had more aphids then the control, the mortality was set on 0.

| | | *Mortality green peach aphids (Myzus persicae) (%)* | | | |
|---|---|---|---|---|---|
| treatment | replicate | 20 May | 25 May | 2 June | 10 June |
| 1 | A | 84 | 73 | 86 | 73 |
| 1 | B | 0 | 81 | 79 | 60 |
| 1 | C | 31 | 99 | 90 | 91 |
| 1 | D | 0 | 43 | 0 | 0 |
| 2 | A | 0 | 0 | 0 | 0 |
| 2 | B | 0 | 0 | 0 | 0 |
| 2 | C | 0 | 0 | 0 | 0 |
| 2 | D | 0 | 0 | 0 | 0 |
| 3 | A | 0 | 69 | 63 | 92 |
| 3 | B | 0 | 67 | 48 | 40 |
| 3 | C | 49 | 99 | 79 | 73 |
| 3 | D | 0 | 57 | 47 | 25 |
| 4 | A | 10 | 85 | 83 | 86 |
| 4 | B | 0 | 88 | 24 | 80 |
| 4 | C | 82 | 98 | 79 | 80 |
| 4 | D | 21 | 65 | 0 | 0 |
| 5 | A | 10 | 96 | 71 | 97 |
| 5 | B | 0 | 100 | 48 | 20 |
| 5 | C | 57 | 99 | 81 | 92 |
| 5 | D | 0 | 57 | 0 | 50 |
| 6 | A | 14 | 22 | 6 | 89 |
| 6 | B | 61 | 100 | 90 | 100 |
| 6 | C | 11 | 98 | 85 | 80 |
| 6 | D | 0 | 0 | 0 | 0 |
| 7 | A | 0 | 95 | 43 | 92 |
| 7 | B | 0 | 100 | 66 | 20 |
| 7 | C | 0 | 99 | 97 | 96 |
| 7 | D | 0 | 91 | 7 | 25 |
| 8 | A | 38 | 98 | 69 | 81 |
| 8 | B | 0 | 100 | 59 | 20 |
| 8 | C | 60 | 99 | 93 | 87 |
| 8 | D | 66 | 91 | 27 | 50 |
| 9 | A | 74 | 99 | 86 | 81 |
| 9 | B | 0 | 91 | 24 | 0 |
| 9 | C | 77 | 100 | 89 | 84 |
| 9 | D | 63 | 100 | 73 | 50 |
| 10 | A | 29 | 72 | 29 | 89 |
| 10 | B | 0 | 81 | 76 | 80 |
| 10 | C | 63 | 99 | 88 | 99 |
| 10 | D | 47 | 96 | 0 | 100 |

| | | *Mortality green peach aphids (*Myzus persicae*) (%)* | | | |
|---|---|---|---|---|---|
| treatment | replicate | 20 May | 25 May | 2 June | 10 June |
| 11 | A | 37 | 85 | 100 | 86 |
| 11 | B | 0 | 56 | 0 | 0 |
| 11 | C | 79 | 100 | 95 | 85 |
| 11 | D | 69 | 100 | 33 | 50 |
| 12 | A | 0 | 94 | 86 | 68 |
| 12 | B | 0 | 93 | 79 | 60 |
| 12 | C | 73 | 98 | 93 | 85 |
| 12 | D | 82 | 91 | 7 | 0 |

## Annex F Raw data *Aphis fabae*

**Table F.1.** Number of black bean aphids (*Aphis fabae*) per 12 plants at the field trial in Westmaas (2020).

| *treatment* | *replicate* | *Number of* Aphis fabae *per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 1 | A | 310 | 21 | 7 | 14 | 62 |
| 1 | B | 233 | 423 | 12 | 0 | 9 |
| 1 | C | 259 | 818 | 0 | 21 | 22 |
| 1 | D | 306 | 370 | 83 | 21 | 15 |
| 2 | A | 401 | 1094 | 731 | 320 | 408 |
| 2 | B | 125 | 10 | 19 | 2 | 18 |
| 2 | C | 199 | 318 | 130 | 97 | 185 |
| 2 | D | 253 | 35 | 2 | 25 | 16 |
| 3 | A | 75 | 300 | 8 | 0 | 2 |
| 3 | B | 58 | 137 | 10 | 24 | 25 |
| 3 | C | 102 | 467 | 3 | 21 | 13 |
| 3 | D | 248 | 43 | 1 | 8 | 2 |
| 4 | A | * | 50 | 13 | 23 | 43 |
| 4 | B | * | 56 | 11 | 11 | 3 |
| 4 | C | * | 37 | 1 | 7 | 10 |
| 4 | D | * | 221 | 18 | 41 | 25 |
| 5 | A | * | 558 | 1 | 7 | 66 |
| 5 | B | * | 74 | 11 | 8 | 23 |
| 5 | C | * | 177 | 3 | 26 | 7 |
| 5 | D | * | 1105 | 3 | 16 | 4 |
| 6 | A | * | 445 | 112 | 1 | 10 |
| 6 | B | * | 172 | 2 | 6 | 10 |
| 6 | C | * | 424 | 1 | 6 | 6 |
| 6 | D | * | 155 | 29 | 2 | 1 |
| 7 | A | * | 347 | 2 | 9 | 34 |
| 7 | B | * | 89 | 11 | 10 | 17 |
| 7 | C | * | 253 | 1 | 0 | 8 |
| 7 | D | * | 438 | 7 | 5 | 4 |
| 8 | A | 118 | 94 | 1 | 19 | 36 |
| 8 | B | 60 | 19 | 8 | 7 | 7 |
| 8 | C | 112 | 349 | 65 | 5 | 41 |
| 8 | D | 123 | 110 | 0 | 37 | 11 |
| 9 | A | 49 | 18 | 3 | 4 | 23 |
| 9 | B | 37 | 4 | 1 | 8 | 3 |
| 9 | C | 29 | 23 | 3 | 1 | 59 |
| 9 | D | 403 | 140 | 0 | 9 | 0 |
| 10 | A | 64 | 202 | 55 | 0 | 1 |
| 10 | B | 103 | 52 | 38 | 81 | 22 |
| 10 | C | 94 | 108 | 1 | 1 | 19 |
| 10 | D | 175 | 64 | 7 | 21 | 24 |

| *treatment* | *replicate* | *Number of* Aphis fabae *per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 11 | A | 244 | 400 | 19 | 6 | 73 |
| 11 | B | 42 | 38 | 6 | 5 | 17 |
| 11 | C | 339 | 25 | 0 | 10 | 45 |
| 11 | D | 208 | 246 | 0 | 5 | 27 |
| 12 | A | 62 | 133 | 6 | 4 | 33 |
| 12 | B | 144 | 90 | 14 | 13 | 23 |
| 12 | C | 457 | 454 | 81 | 23 | 13 |
| 12 | D | 58 | 15 | 1 | 9 | 34 |
| 13 | A | * | 614 | 573 | 15 | 92 |
| 13 | B | * | 34 | 12 | 23 | 1 |
| 13 | C | * | 621 | 131 | 17 | 0 |
| 13 | D | * | 979 | 1328 | 1127 | 1094 |
| 14 | A | * | 606 | 595 | 538 | 997 |
| 14 | B | * | 127 | 59 | 92 | 36 |
| 14 | C | * | 1470 | 675 | 2425 | 1438 |
| 14 | D | * | 66 | 153 | 69 | 123 |
| 15 | A | * | 199 | 115 | 373 | 738 |
| 15 | B | * | 51 | 3 | 6 | 25 |
| 15 | C | * | 137 | 4 | 20 | 23 |
| 15 | D | * | 26 | 32 | 39 | 6 |

*These plots were not counted on the 13th of May.

**Table F.2.** Mortality (%) of black bean aphids (*Aphis fabae*) according to Abbott's formula at the field trial in Westmaas (2020). When a specific plot had more aphids then the control, the mortality was set on 0.

| | | *Mortality black bean aphids (Aphis fabae) (%)* | | | |
|---|---|---|---|---|---|
| treatment | replicate | 20 May | 25 May | 2 June | 10 June |
| 1 | A | 98 | 99 | 96 | 85 |
| 1 | B | 0 | 37 | 100 | 50 |
| 1 | C | 0 | 100 | 78 | 88 |
| 1 | D | 0 | 0 | 16 | 6 |
| 2 | A | 0 | 0 | 0 | 0 |
| 2 | B | 0 | 0 | 0 | 0 |
| 2 | C | 0 | 0 | 0 | 0 |
| 2 | D | 0 | 0 | 0 | 0 |
| 3 | A | 73 | 99 | 100 | 100 |
| 3 | B | 0 | 47 | 0 | 0 |
| 3 | C | 0 | 98 | 78 | 93 |
| 3 | D | 0 | 50 | 68 | 88 |
| 4 | A | 95 | 98 | 93 | 89 |
| 4 | B | 0 | 42 | 0 | 83 |
| 4 | C | 88 | 99 | 93 | 95 |
| 4 | D | 0 | 0 | 0 | 0 |
| 5 | A | 49 | 100 | 98 | 84 |
| 5 | B | 0 | 42 | 0 | 0 |
| 5 | C | 44 | 98 | 73 | 96 |
| 5 | D | 0 | 0 | 36 | 75 |
| 6 | A | 59 | 85 | 100 | 98 |
| 6 | B | 0 | 89 | 0 | 44 |
| 6 | C | 0 | 99 | 94 | 97 |
| 6 | D | 0 | 0 | 92 | 94 |
| 7 | A | 68 | 100 | 97 | 92 |
| 7 | B | 0 | 42 | 0 | 6 |
| 7 | C | 20 | 99 | 100 | 96 |
| 7 | D | 0 | 0 | 80 | 75 |
| 8 | A | 91 | 100 | 94 | 91 |
| 8 | B | 0 | 58 | 0 | 61 |
| 8 | C | 0 | 50 | 95 | 78 |
| 8 | D | 0 | 100 | 0 | 31 |
| 9 | A | 98 | 100 | 99 | 94 |
| 9 | B | 60 | 95 | 0 | 83 |
| 9 | C | 93 | 98 | 99 | 68 |
| 9 | D | 0 | 100 | 64 | 100 |
| 10 | A | 82 | 92 | 100 | 100 |
| 10 | B | 0 | 0 | 0 | 0 |
| 10 | C | 66 | 99 | 99 | 90 |
| 10 | D | 0 | 0 | 16 | 0 |

| | | Mortality black bean aphids (*Aphis fabae*) (%) | | | |
|---|---|---|---|---|---|
| treatment | replicate | 20 May | 25 May | 2 June | 10 June |
| 11 | A | 63 | 97 | 98 | 82 |
| 11 | B | 0 | 68 | 0 | 6 |
| 11 | C | 92 | 100 | 90 | 76 |
| 11 | D | 0 | 100 | 80 | 0 |
| 12 | A | 88 | 99 | 99 | 92 |
| 12 | B | 0 | 26 | 0 | 0 |
| 12 | C | 0 | 38 | 76 | 93 |
| 12 | D | 57 | 50 | 64 | 0 |

# Annex G Raw data other aphids

**Table G.1.** Number of other aphids per 12 plants at the field trial in Westmaas (2020).

| *treatment* | *replicate* | *Number of other aphids per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 1 | A | 93 | 23 | 2 | 9 | 2 |
| 1 | B | 158 | 37 | 0 | 4 | 0 |
| 1 | C | 97 | 103 | 3 | 9 | 0 |
| 1 | D | 32 | 44 | 1 | 0 | 1 |
| 2 | A | 90 | 23 | 89 | 13 | 0 |
| 2 | B | 91 | 33 | 9 | 6 | 2 |
| 2 | C | 46 | 88 | 201 | 23 | 5 |
| 2 | D | 30 | 46 | 12 | 7 | 5 |
| 3 | A | 39 | 12 | 0 | 12 | 0 |
| 3 | B | 92 | 113 | 0 | 4 | 3 |
| 3 | C | 37 | 45 | 1 | 2 | 4 |
| 3 | D | 64 | 31 | 0 | 5 | 1 |
| 4 | A | * | 3 | 2 | 6 | 0 |
| 4 | B | * | 34 | 0 | 0 | 1 |
| 4 | C | * | 17 | 6 | 2 | 3 |
| 4 | D | * | 19 | 3 | 1 | 1 |
| 5 | A | * | 26 | 1 | 2 | 0 |
| 5 | B | * | 32 | 2 | 2 | 0 |
| 5 | C | * | 52 | 1 | 7 | 1 |
| 5 | D | * | 7 | 1 | 1 | 0 |
| 6 | A | * | 23 | 73 | 15 | 0 |
| 6 | B | * | 22 | 4 | 2 | 4 |
| 6 | C | * | 100 | 2 | 40 | 9 |
| 6 | D | * | 16 | 4 | 1 | 1 |
| 7 | A | * | 28 | 2 | 5 | 0 |
| 7 | B | * | 13 | 0 | 0 | 0 |
| 7 | C | * | 96 | 1 | 1 | 1 |
| 7 | D | * | 11 | 0 | 5 | 10 |
| 8 | A | 134 | 53 | 2 | 5 | 5 |
| 8 | B | 59 | 3 | 0 | 2 | 5 |
| 8 | C | 22 | 64 | 0 | 4 | 1 |
| 8 | D | 36 | 21 | 0 | 1 | 1 |
| 9 | A | 61 | 25 | 1 | 22 | 1 |
| 9 | B | 56 | 17 | 0 | 4 | 1 |
| 9 | C | 29 | 18 | 2 | 13 | 1 |
| 9 | D | 33 | 4 | 0 | 4 | 0 |
| 10 | A | 133 | 26 | 2 | 3 | 0 |
| 10 | B | 86 | 31 | 3 | 0 | 0 |
| 10 | C | 29 | 21 | 0 | 3 | 1 |
| 10 | D | 24 | 15 | 0 | 1 | 1 |

| *treatment* | *replicate* | *Number of other aphids per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 11 | A | 96 | 35 | 2 | 0 | 0 |
| 11 | B | 67 | 53 | 7 | 5 | 3 |
| 11 | C | 43 | 25 | 0 | 10 | 0 |
| 11 | D | 17 | 12 | 0 | 0 | 1 |
| 12 | A | 183 | 19 | 5 | 3 | 0 |
| 12 | B | 63 | 8 | 0 | 2 | 1 |
| 12 | C | 66 | 31 | 2 | 4 | 0 |
| 12 | D | 66 | 21 | 1 | 0 | 2 |
| 13 | A | * | 75 | 194 | 15 | 1 |
| 13 | B | * | 21 | 11 | 3 | 10 |
| 13 | C | * | 65 | 24 | 13 | 5 |
| 13 | D | * | 93 | 3 | 11 | 5 |
| 14 | A | * | 38 | 30 | 4 | 0 |
| 14 | B | * | 17 | 1 | 2 | 3 |
| 14 | C | * | 39 | 91 | 14 | 35 |
| 14 | D | * | 88 | 1 | 1 | 2 |
| 15 | A | * | 46 | 83 | 15 | 10 |
| 15 | B | * | 123 | 16 | 1 | 5 |
| 15 | C | * | 43 | 19 | 29 | 0 |
| 15 | D | * | 68 | 16 | 1 | 2 |

*this plot was not counted on the 13th of May.

## Annex H Raw data beneficials

**Table H.1.** Number of beneficials (eggs, larvae and adults of ladybird beetles, soldier beetles, spiders, parasitic wasps, hoverflies, lacewings) per 12 plants at the field trial in Westmaas (2020).

| *treatment* | *replicate* | *Number of beneficials per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 1 | A | 7 | 3 | 9 | 4 | 2 |
| 1 | B | 4 | 13 | 7 | 10 | 4 |
| 1 | C | 0 | 8 | 9 | 6 | 13 |
| 1 | D | 5 | 2 | 10 | 6 | 1 |
| 2 | A | 6 | 8 | 29 | 22 | 16 |
| 2 | B | 4 | 7 | 2 | 7 | 3 |
| 2 | C | 3 | 9 | 28 | 20 | 25 |
| 2 | D | 6 | 8 | 13 | 7 | 2 |
| 3 | A | 2 | 8 | 7 | 4 | 3 |
| 3 | B | 5 | 17 | 3 | 4 | 5 |
| 3 | C | 1 | 16 | 8 | 6 | 4 |
| 3 | D | 9 | 6 | 2 | 2 | 1 |
| 4 | A | * | 4 | 7 | 9 | 7 |
| 4 | B | * | 6 | 4 | 23 | 1 |
| 4 | C | * | 10 | 5 | 3 | 4 |
| 4 | D | * | 16 | 12 | 9 | 7 |
| 5 | A | * | 6 | 18 | 7 | 4 |
| 5 | B | * | 6 | 3 | 2 | 2 |
| 5 | C | * | 7 | 6 | 3 | 6 |
| 5 | D | * | 13 | 2 | 6 | 11 |
| 6 | A | * | 5 | 23 | 10 | 5 |
| 6 | B | * | 8 | 4 | 6 | 1 |
| 6 | C | * | 12 | 14 | 9 | 7 |
| 6 | D | * | 10 | 25 | 4 | 1 |
| 7 | A | * | 6 | 12 | 2 | 8 |
| 7 | B | * | 3 | 4 | 0 | 1 |
| 7 | C | * | 6 | 11 | 4 | 12 |
| 7 | D | * | 12 | 2 | 3 | 2 |
| 8 | A | 4 | 40 | 6 | 6 | 3 |
| 8 | B | 4 | 9 | 1 | 4 | 1 |
| 8 | C | 2 | 8 | 19 | 8 | 4 |
| 8 | D | 2 | 14 | 6 | 7 | 1 |
| 9 | A | 6 | 10 | 12 | 2 | 2 |
| 9 | B | 6 | 4 | 4 | 13 | 3 |
| 9 | C | 0 | 5 | 6 | 9 | 8 |
| 9 | D | 4 | 1 | 1 | 3 | 3 |

| *treatment* | *replicate* | *Number of beneficials per 12 plants* | | | | |
|---|---|---|---|---|---|---|
| | | 13 May | 20 May | 25 May | 2 June | 10 June |
| 10 | A | 4 | 9 | 5 | 4 | 4 |
| 10 | B | 5 | 8 | 4 | 7 | 2 |
| 10 | C | 3 | 25 | 6 | 4 | 2 |
| 10 | D | 2 | 11 | 7 | 3 | 3 |
| 11 | A | 4 | 4 | 11 | 5 | 5 |
| 11 | B | 8 | 7 | 7 | 15 | 4 |
| 11 | C | 4 | 8 | 4 | 6 | 5 |
| 11 | D | 6 | 8 | 10 | 5 | 1 |
| 12 | A | 3 | 6 | 14 | 4 | 8 |
| 12 | B | 10 | 4 | 5 | 4 | 6 |
| 12 | C | 4 | 12 | 16 | 12 | 15 |
| 12 | D | 5 | 6 | 2 | 2 | 3 |
| 13 | A | * | 12 | 91 | 27 | 11 |
| 13 | B | * | 7 | 6 | 3 | 1 |
| 13 | C | * | 8 | 17 | 9 | 15 |
| 13 | D | * | 13 | 40 | 18 | 7 |
| 14 | A | * | 7 | 36 | 28 | 14 |
| 14 | B | * | 7 | 5 | 10 | 4 |
| 14 | C | * | 10 | 25 | 17 | 6 |
| 14 | D | * | 10 | 21 | 9 | 7 |
| 15 | A | * | 4 | 14 | 9 | 12 |
| 15 | B | * | 16 | 15 | 4 | 9 |
| 15 | C | * | 9 | 17 | 9 | 6 |
| 15 | D | * | 5 | 10 | 8 | 7 |

*this plot was not counted on the 13th of May.

# Annex I Raw data plant numbers and virus yellows

**Table I.1.** Number of plants per plot, number of plants with virus yellows and percentage of plants with virus yellows at the field trial in Westmaas (2020).

| *treatment* | *replicate* | *number of plants per plot* | *number of plants with virus yellows per plot* | | | *percentage of plants with virus yellows* | | |
|---|---|---|---|---|---|---|---|---|
| | | 28 May | 6 July | 11 August | 11 September | 6 July | 11 August | 11 September |
| 1 | A | 367 | 1 | 0 | 4 | 0.3 | 0.0 | 1.1 |
| 1 | B | 360 | 0 | 3 | 5 | 0.0 | 0.8 | 1.4 |
| 1 | C | 314 | 0 | 2 | 3 | 0.0 | 0.6 | 1.0 |
| 1 | D | 372 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| 2 | A | 352 | 65 | 68 | 118 | 18.5 | 19.3 | 33.5 |
| 2 | B | 342 | 11 | 22 | 28 | 3.2 | 6.4 | 8.2 |
| 2 | C | 329 | 75 | 101 | 133 | 22.8 | 30.7 | 40.4 |
| 2 | D | 295 | 19 | 41 | 66 | 6.4 | 13.9 | 22.4 |
| 3 | A | 347 | 27 | 23 | 45 | 7.8 | 6.6 | 13.0 |
| 3 | B | 330 | 11 | 29 | 31 | 3.3 | 8.8 | 9.4 |
| 3 | C | 284 | 22 | 24 | 49 | 7.7 | 8.5 | 17.3 |
| 3 | D | 362 | 12 | 16 | 15 | 3.3 | 4.4 | 4.1 |
| 4 | A | 346 | 24 | 20 | 41 | 6.9 | 5.8 | 11.8 |
| 4 | B | 338 | 24 | 24 | 50 | 7.1 | 7.1 | 14.8 |
| 4 | C | 332 | 16 | 16 | 38 | 4.8 | 4.8 | 11.4 |
| 4 | D | 313 | 17 | 24 | 47 | 5.4 | 7.7 | 15.0 |
| 5 | A | 259 | 19 | 9 | 32 | 7.3 | 3.5 | 12.4 |
| 5 | B | 335 | 14 | 13 | 31 | 4.2 | 3.9 | 9.3 |
| 5 | C | 349 | 18 | 19 | 45 | 5.2 | 5.4 | 12.9 |
| 5 | D | 318 | 11 | 31 | 42 | 3.5 | 9.7 | 13.2 |
| 6 | A | 365 | 29 | 42 | 84 | 7.9 | 11.5 | 23.0 |
| 6 | B | 337 | 17 | 18 | 27 | 5.0 | 5.3 | 8.0 |
| 6 | C | 312 | 21 | 31 | 60 | 6.7 | 9.9 | 19.2 |
| 6 | D | 356 | 15 | 25 | 40 | 4.2 | 7.0 | 11.2 |
| 7 | A | 354 | 10 | 15 | 35 | 2.8 | 4.2 | 9.9 |
| 7 | B | 326 | 11 | 12 | 17 | 3.4 | 3.7 | 5.2 |
| 7 | C | 314 | 12 | 17 | 32 | 3.8 | 5.4 | 10.2 |
| 7 | D | 326 | 12 | 27 | 37 | 3.7 | 8.3 | 11.3 |
| 8 | A | 246 | 12 | 19 | 43 | 4.9 | 7.7 | 17.5 |
| 8 | B | 321 | 5 | 22 | 28 | 1.6 | 6.9 | 8.7 |
| 8 | C | 335 | 20 | 29 | 50 | 6.0 | 8.7 | 14.9 |
| 8 | D | 323 | 17 | 26 | 40 | 5.3 | 8.0 | 12.4 |
| 9 | A | 355 | 21 | 24 | 47 | 5.9 | 6.8 | 13.2 |
| 9 | B | 339 | 24 | 24 | 39 | 7.1 | 7.1 | 11.5 |
| 9 | C | 320 | 15 | 22 | 60 | 4.7 | 6.9 | 18.8 |
| 9 | D | 376 | 6 | 16 | 19 | 1.6 | 4.3 | 5.1 |

| *treatment* | *replicate* | *number of plants per plot* | *number of plants with virus yellows per plot* | | | *percentage of plants with virus yellows* | | |
|---|---|---|---|---|---|---|---|---|
| | | 28 May | 6 July | 11 August | 11 September | 6 July | 11 August | 11 September |
| 10 | A | 365 | 20 | 28 | 56 | 5.5 | 7.7 | 15.3 |
| 10 | B | 342 | 25 | 20 | 41 | 7.3 | 5.8 | 12.0 |
| 10 | C | 360 | 14 | 12 | 31 | 3.9 | 3.3 | 8.6 |
| 10 | D | 364 | 9 | 9 | 22 | 2.5 | 2.5 | 6.0 |
| 11 | A | 337 | 14 | 22 | 35 | 4.2 | 6.5 | 10.4 |
| 11 | B | 329 | 28 | 36 | 53 | 8.5 | 10.9 | 16.1 |
| 11 | C | 272 | 24 | 22 | 46 | 8.8 | 8.1 | 16.9 |
| 11 | D | 338 | 8 | 11 | 15 | 2.4 | 3.3 | 4.4 |
| 12 | A | 362 | 20 | 26 | 65 | 5.5 | 7.2 | 18.0 |
| 12 | B | 362 | 14 | 24 | 38 | 3.9 | 6.6 | 10.5 |
| 12 | C | 345 | 22 | 47 | 54 | 6.4 | 13.6 | 15.7 |
| 12 | D | 334 | 6 | 15 | 18 | 1.8 | 4.5 | 5.4 |
| 13 | A | 354 | 61 | 103 | 141 | 17.2 | 29.1 | 39.8 |
| 13 | B | 338 | 15 | 49 | 57 | 4.4 | 14.5 | 16.9 |
| 13 | C | 299 | 39 | 53 | 71 | 13.0 | 17.7 | 23.7 |
| 13 | D | 308 | 41 | 57 | 91 | 13.3 | 18.5 | 29.5 |
| 14 | A | 329 | 106 | 123 | 187 | 32.2 | 37.4 | 56.8 |
| 14 | B | 352 | 26 | 34 | 60 | 7.4 | 9.7 | 17.0 |
| 14 | C | 281 | 41 | 48 | 69 | 14.6 | 17.1 | 24.6 |
| 14 | D | 321 | 24 | 40 | 64 | 7.5 | 12.5 | 19.9 |
| 15 | A | 312 | 50 | 75 | 114 | 16.0 | 24.0 | 36.5 |
| 15 | B | 315 | 24 | 51 | 59 | 7.6 | 16.2 | 18.7 |
| 15 | C | 227 | 51 | 69 | 101 | 22.5 | 30.4 | 44.5 |
| 15 | D | 331 | 32 | 42 | 66 | 9.7 | 12.7 | 19.9 |

# Annex J Raw data phytotoxicity

**Table J.1.** Number of plants per plot with phytotox symptoms at the field trial in Westmaas (2020).

| *treatment* | *replicate* | *Number of plants with phytotox symptoms* | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 20 May | 25 May | 2 June | 10 June | 6 July | 11 August | 11 September |
| 1 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| *treatment* | *replicate* | *Number of plants with phytotox symptoms* | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 20 May | 25 May | 2 June | 10 June | 6 July | 11 August | 11 September |
| 11 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | A | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | B | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | C | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | D | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Annex K Weather data

**Table K.1.** Weather data from the nearest KNMI weather station (Rotterdam).

| *date* | *air temperature max* | *air temperature min* | *air temperature average* | *% humidity max* | *% humidity min* | *% humidity average* | *precipi-tation total (mm)* | *wind-speed (m/s)* |
|---|---|---|---|---|---|---|---|---|
| 20200301 | 8.5 | 5.0 | 6.3 | 85 | 71 | 79 | 0.7 | 8.5 |
| 20200302 | 8.0 | 0.3 | 5.3 | 95 | 84 | 90 | 6.5 | 4.1 |
| 20200303 | 9.1 | 0.1 | 5.1 | 93 | 66 | 83 | 1.2 | 4.5 |
| 20200304 | 10.2 | 3.1 | 7.2 | 95 | 53 | 78 | 0.3 | 3.5 |
| 20200305 | 6.9 | 4.9 | 5.6 | 96 | 87 | 93 | 16.9 | 5.5 |
| 20200306 | 8.8 | 3.7 | 6.4 | 94 | 79 | 86 | 5.3 | 4.7 |
| 20200307 | 10.8 | 0.6 | 6.9 | 94 | 65 | 79 | 0.2 | 5.5 |
| 20200308 | 10.8 | 7.1 | 8.7 | 93 | 77 | 84 | 0.4 | 7.5 |
| 20200309 | 10.4 | 6.3 | 7.8 | 92 | 74 | 83 | 3.9 | 6.2 |
| 20200310 | 11.5 | 6.6 | 10.2 | 96 | 91 | 94 | 15.4 | 10.0 |
| 20200311 | 13.0 | 9.3 | 11.0 | 95 | 76 | 87 | 2.0 | 7.3 |
| 20200312 | 10.8 | 6.7 | 8.4 | 88 | 56 | 69 | 0.5 | 10.6 |
| 20200313 | 10.0 | 2.3 | 6.8 | 98 | 71 | 83 | 2.3 | 5.5 |
| 20200314 | 11.6 | 1.1 | 7.2 | 99 | 60 | 83 | 0.3 | 4.8 |
| 20200315 | 11.3 | 7.2 | 9.5 | 90 | 71 | 80 | 0.0 | 5.9 |
| 20200316 | 12.6 | 2.2 | 7.2 | 99 | 65 | 86 | 0.0 | 2.2 |
| 20200317 | 12.8 | 2.8 | 8.6 | 97 | 43 | 71 | 0.0 | 5.5 |
| 20200318 | 13.2 | 6.2 | 10.0 | 95 | 55 | 73 | 0.0 | 5.5 |
| 20200319 | 10.0 | 6.7 | 8.4 | 99 | 79 | 90 | 0.0 | 3.3 |
| 20200320 | 8.8 | 3.5 | 6.8 | 88 | 61 | 76 | <0.1 | 5.8 |
| 20200321 | 9.7 | 0.6 | 5.0 | 91 | 51 | 65 | 0.0 | 7.1 |
| 20200322 | 9.7 | -0.4 | 4.8 | 75 | 39 | 55 | 0.0 | 6.8 |
| 20200323 | 10.0 | 0.0 | 5.4 | 63 | 27 | 43 | 0.0 | 5.9 |
| 20200324 | 11.9 | -2.8 | 6.6 | 70 | 24 | 38 | 0.0 | 4.4 |
| 20200325 | 12.1 | 0.4 | 6.1 | 60 | 24 | 41 | 0.0 | 4.0 |
| 20200326 | 11.4 | -1.4 | 6.0 | 72 | 30 | 48 | 0.0 | 4.7 |
| 20200327 | 13.7 | 1.9 | 7.9 | 77 | 43 | 60 | 0.0 | 5.2 |
| 20200328 | 11.9 | 4.6 | 7.7 | 77 | 49 | 65 | 0.0 | 6.6 |
| 20200329 | 7.4 | -0.7 | 4.6 | 79 | 33 | 53 | 0.1 | 8.0 |
| 20200330 | 9.7 | -2.0 | 4.2 | 89 | 62 | 77 | 1.8 | 2.9 |
| 20200331 | 9.2 | -0.1 | 4.3 | 93 | 37 | 66 | 0.0 | 3.5 |
| 20200401 | 8.6 | -2.4 | 4.4 | 97 | 54 | 75 | 0.0 | 1.4 |
| 20200402 | 10.7 | 1.9 | 7.7 | 88 | 53 | 75 | 0.6 | 5.0 |
| 20200403 | 10.3 | 2.5 | 7.1 | 88 | 47 | 72 | 0.0 | 4.0 |
| 20200404 | 15.0 | 1.9 | 9.1 | 84 | 36 | 54 | 0.0 | 3.4 |
| 20200405 | 20.9 | 5.0 | 13.9 | 68 | 26 | 45 | 0.0 | 4.8 |
| 20200406 | 20.6 | 5.9 | 13.5 | 91 | 41 | 60 | <0.1 | 5.2 |
| 20200407 | 18.6 | 3.7 | 12.6 | 98 | 38 | 66 | 0.0 | 2.9 |
| 20200408 | 23.1 | 7.3 | 14.9 | 93 | 42 | 68 | 0.0 | 1.8 |
| 20200409 | 20.2 | 6.4 | 13.3 | 98 | 46 | 70 | 0.0 | 2.8 |
| 20200410 | 18.4 | 4.8 | 11.5 | 89 | 48 | 65 | 0.0 | 3.5 |

| *date* | *air temperature max* | *air temperature min* | *air temperature average* | *% humidity max* | *% humidity min* | *% humidity average* | *precipi-tation total (mm)* | *wind-speed (m/s)* |
|---|---|---|---|---|---|---|---|---|
| 20200411 | 20.4 | 5.1 | 12.7 | 92 | 25 | 53 | 0.0 | 2.1 |
| 20200412 | 22.3 | 5.0 | 14.0 | 97 | 41 | 67 | <0.1 | 2.3 |
| 20200413 | 11.0 | 5.5 | 7.9 | 82 | 45 | 58 | <0.1 | 6.6 |
| 20200414 | 10.0 | 2.3 | 6.2 | 91 | 53 | 69 | 0.1 | 2.5 |
| 20200415 | 16.1 | 0.3 | 8.3 | 95 | 38 | 70 | 0.0 | 1.5 |
| 20200416 | 21.0 | 3.7 | 12.6 | 97 | 33 | 66 | 0.0 | 2.9 |
| 20200417 | 16.1 | 6.2 | 10.7 | 82 | 51 | 68 | 0.0 | 5.8 |
| 20200418 | 13.9 | 5.9 | 10.2 | 94 | 59 | 80 | 1.9 | 2.7 |
| 20200419 | 18.1 | 7.5 | 11.7 | 87 | 33 | 56 | 1.2 | 4.9 |
| 20200420 | 18.5 | 5.5 | 12.7 | 57 | 29 | 42 | 0.0 | 7.5 |
| 20200421 | 19.6 | 8.3 | 14.0 | 54 | 30 | 42 | 0.0 | 7.5 |
| 20200422 | 21.4 | 7.2 | 14.4 | 69 | 27 | 47 | 0.0 | 5.7 |
| 20200423 | 22.4 | 6.7 | 14.3 | 98 | 28 | 60 | 0.0 | 2.3 |
| 20200424 | 18.0 | 6.4 | 11.6 | 98 | 42 | 71 | 0.0 | 3.1 |
| 20200425 | 13.5 | 4.5 | 9.1 | 88 | 54 | 68 | 0.0 | 3.0 |
| 20200426 | 15.7 | 1.4 | 8.7 | 98 | 54 | 78 | 0.0 | 1.5 |
| 20200427 | 19.8 | 2.8 | 12.1 | 98 | 33 | 71 | 0.0 | 2.3 |
| 20200428 | 10.2 | 7.8 | 9.1 | 96 | 85 | 91 | 4.4 | 3.4 |
| 20200429 | 15.7 | 7.9 | 11.6 | 97 | 65 | 83 | 3.2 | 4.6 |
| 20200430 | 16.5 | 8.6 | 11.5 | 88 | 42 | 71 | 2.4 | 6.9 |
| 20200501 | 14.1 | 8.7 | 10.6 | 90 | 65 | 80 | 5.5 | 6.5 |
| 20200502 | 13.7 | 7.4 | 10.7 | 90 | 65 | 76 | 0.0 | 4.5 |
| 20200503 | 17.1 | 8.0 | 12.6 | 91 | 48 | 74 | 0.5 | 2.6 |
| 20200504 | 16.0 | 5.3 | 11.3 | 94 | 48 | 72 | 0.5 | 4.2 |
| 20200505 | 14.4 | 3.8 | 9.5 | 89 | 44 | 64 | 0.0 | 4.4 |
| 20200506 | 17.3 | 3.1 | 10.7 | 91 | 32 | 64 | 0.0 | 3.0 |
| 20200507 | 20.1 | 4.1 | 13.0 | 97 | 32 | 61 | 0.0 | 1.6 |
| 20200508 | 21.9 | 6.3 | 15.0 | 98 | 30 | 61 | 0.0 | 1.5 |
| 20200509 | 24.8 | 7.8 | 17.5 | 97 | 32 | 59 | 0.0 | 3.5 |
| 20200510 | 22.1 | 7.9 | 13.4 | 89 | 49 | 70 | 0.0 | 5.3 |
| 20200511 | 12.7 | 3.7 | 8.5 | 85 | 35 | 51 | 0.0 | 7.4 |
| 20200512 | 13.2 | 2.4 | 8.2 | 90 | 36 | 65 | <0.1 | 2.3 |
| 20200513 | 12.8 | 3.2 | 8.1 | 95 | 45 | 62 | 0.0 | 4.4 |
| 20200514 | 12.7 | 1.0 | 7.9 | 82 | 46 | 59 | 0.0 | 4.0 |
| 20200515 | 15.2 | 0.4 | 9.6 | 91 | 48 | 66 | 0.0 | 2.0 |
| 20200516 | 15.5 | 4.6 | 10.5 | 98 | 52 | 73 | 0.0 | 3.5 |
| 20200517 | 18.8 | 5.8 | 13.3 | 98 | 38 | 63 | 0.0 | 3.8 |
| 20200518 | 20.0 | 10.0 | 14.9 | 87 | 40 | 66 | 0.0 | 4.5 |
| 20200519 | 20.8 | 10.2 | 15.7 | 98 | 58 | 75 | 0.0 | 2.8 |
| 20200520 | 22.9 | 10.0 | 17.0 | 98 | 46 | 70 | 0.0 | 2.1 |
| 20200521 | 27.2 | 10.7 | 20.2 | 91 | 36 | 61 | 0.0 | 1.8 |
| 20200522 | 23.4 | 14.3 | 18.9 | 84 | 29 | 57 | 0.2 | 7.2 |
| 20200523 | 18.9 | 12.9 | 14.9 | 82 | 48 | 67 | 0.0 | 7.9 |
| 20200524 | 15.6 | 11.7 | 13.7 | 89 | 66 | 78 | 0.8 | 4.9 |

| *date* | *air temperature max* | *air temperature min* | *air temperature average* | *% humidity max* | *% humidity min* | *% humidity average* | *precipi-tation total (mm)* | *wind-speed (m/s)* |
|---|---|---|---|---|---|---|---|---|
| 20200525 | 20.2 | 8.8 | 15.2 | 98 | 52 | 71 | <0.1 | 2.7 |
| 20200526 | 23.6 | 8.3 | 16.3 | 98 | 39 | 67 | 0.0 | 2.0 |
| 20200527 | 21.2 | 11.0 | 15.2 | 94 | 42 | 69 | 0.0 | 3.3 |
| 20200528 | 20.3 | 8.8 | 14.7 | 77 | 29 | 55 | 0.0 | 5.3 |
| 20200529 | 22.0 | 6.0 | 15.2 | 89 | 33 | 60 | 0.0 | 3.9 |
| 20200530 | 24.6 | 8.0 | 17.5 | 85 | 28 | 53 | 0.0 | 4.3 |
| 20200531 | 23.2 | 11.2 | 17.5 | 84 | 33 | 53 | 0.0 | 5.1 |
| 20200601 | 24.4 | 10.0 | 18.4 | 93 | 33 | 57 | 0.0 | 3.6 |
| 20200602 | 26.2 | 10.9 | 18.3 | 98 | 35 | 67 | 0.0 | 2.1 |
| 20200603 | 21.6 | 10.8 | 16.2 | 98 | 46 | 76 | 0.0 | 3.5 |
| 20200604 | 16.7 | 7.9 | 12.7 | 90 | 70 | 78 | 0.7 | 4.6 |
| 20200605 | 14.2 | 6.2 | 10.4 | 94 | 64 | 81 | 16.8 | 5.1 |
| 20200606 | 16.5 | 8.0 | 11.8 | 91 | 43 | 70 | 7.3 | 7.9 |
| 20200607 | 15.8 | 9.4 | 12.3 | 95 | 65 | 83 | 5.8 | 4.5 |
| 20200608 | 17.8 | 10.8 | 13.7 | 98 | 66 | 80 | 2.1 | 3.5 |
| 20200609 | 16.5 | 7.6 | 12.7 | 91 | 54 | 67 | 0.0 | 3.0 |
| 20200610 | 17.7 | 6.7 | 13.5 | 94 | 58 | 79 | <0.1 | 1.6 |
| 20200611 | 18.6 | 12.4 | 15.1 | 95 | 71 | 85 | 1.5 | 2.8 |
| 20200612 | 26.7 | 12.3 | 18.7 | 97 | 44 | 78 | 17.5 | 4.0 |
| 20200613 | 25.1 | 15.1 | 19.8 | 97 | 49 | 76 | 0.9 | 2.7 |
| 20200614 | 20.5 | 14.3 | 17.4 | 98 | 66 | 85 | 26.1 | 2.2 |
| 20200615 | 24.2 | 14.8 | 19.3 | 87 | 52 | 68 | <0.1 | 2.5 |
| 20200616 | 23.1 | 15.1 | 18.1 | 96 | 67 | 83 | 2.5 | 2.1 |
| 20200617 | 25.2 | 13.7 | 19.4 | 98 | 48 | 78 | 30.6 | 3.1 |
| 20200618 | 23.0 | 13.2 | 17.4 | 99 | 56 | 84 | 10.0 | 3.0 |
| 20200619 | 21.7 | 11.4 | 16.9 | 99 | 59 | 77 | 0.0 | 3.6 |
| 20200620 | 21.5 | 12.6 | 17.4 | 92 | 52 | 71 | 0.0 | 2.8 |
| 20200621 | 24.7 | 14.8 | 18.7 | 92 | 55 | 69 | 0.0 | 5.1 |
| 20200622 | 21.6 | 12.0 | 17.4 | 98 | 46 | 67 | 0.0 | 2.5 |
| 20200623 | 25.2 | 11.3 | 19.8 | 94 | 45 | 63 | 0.0 | 2.0 |
| 20200624 | 30.1 | 14.8 | 23.3 | 90 | 34 | 56 | 0.0 | 3.8 |
| 20200625 | 29.5 | 16.9 | 24.6 | 68 | 39 | 53 | 0.0 | 5.0 |
| 20200626 | 30.9 | 19.6 | 24.3 | 87 | 39 | 64 | 0.6 | 3.3 |
| 20200627 | 24.5 | 17.7 | 20.0 | 94 | 63 | 77 | 1.6 | 5.5 |
| 20200628 | 21.5 | 14.8 | 17.6 | 72 | 46 | 61 | <0.1 | 8.0 |
| 20200629 | 19.6 | 14.0 | 16.2 | 79 | 51 | 66 | 0.1 | 9.0 |
| 20200630 | 19.7 | 14.7 | 16.5 | 97 | 61 | 81 | 12.2 | 6.9 |
| 20200701 | 20.9 | 15.6 | 17.8 | 92 | 63 | 79 | 0.6 | 6.2 |
| 20200702 | 20.3 | 15.0 | 17.4 | 89 | 57 | 77 | 0.1 | 5.4 |
| 20200703 | 21.4 | 11.9 | 17.3 | 94 | 46 | 72 | <0.1 | 7.0 |
| 20200704 | 19.0 | 14.5 | 16.8 | 95 | 80 | 90 | 10.8 | 8.9 |
| 20200705 | 20.9 | 15.4 | 17.6 | 91 | 59 | 79 | 0.0 | 10.0 |
| 20200706 | 18.5 | 10.0 | 14.4 | 96 | 62 | 74 | 0.5 | 5.8 |
| 20200707 | 19.4 | 10.0 | 15.5 | 96 | 58 | 76 | 1.5 | 3.3 |

| *date* | *air temperature max* | *air temperature min* | *air temperature average* | *% humidity max* | *% humidity min* | *% humidity average* | *precipi-tation total (mm)* | *wind-speed (m/s)* |
|---|---|---|---|---|---|---|---|---|
| 20200708 | 18.4 | 13.4 | 15.9 | 97 | 82 | 91 | 5.5 | 2.4 |
| 20200709 | 18.2 | 15.9 | 17.1 | 97 | 87 | 92 | 6.4 | 6.1 |
| 20200710 | 18.1 | 10.4 | 15.1 | 98 | 60 | 81 | 4.8 | 3.4 |
| 20200711 | 19.4 | 9.1 | 14.6 | 97 | 60 | 80 | 0.6 | 2.5 |
| 20200712 | 20.4 | 8.5 | 15.2 | 99 | 54 | 73 | 0.0 | 1.7 |
| 20200713 | 22.6 | 9.0 | 17.8 | 98 | 39 | 64 | 0.0 | 1.9 |
| 20200714 | 18.1 | 11.2 | 15.9 | 95 | 73 | 86 | 7.8 | 2.4 |
| 20200715 | 20.4 | 9.7 | 16.1 | 97 | 58 | 76 | 0.0 | 2.3 |
| 20200716 | 20.2 | 14.5 | 16.6 | 96 | 72 | 86 | 2.6 | 3.1 |
| 20200717 | 23.4 | 14.4 | 18.4 | 96 | 56 | 81 | <0.1 | 1.5 |
| 20200718 | 25.4 | 13.6 | 19.5 | 97 | 63 | 78 | 0.0 | 2.9 |
| 20200719 | 22.7 | 12.3 | 17.1 | 99 | 65 | 85 | 3.2 | 2.6 |
| 20200720 | 20.3 | 10.1 | 15.3 | 96 | 49 | 74 | 0.0 | 2.8 |
| 20200721 | 20.7 | 8.8 | 15.2 | 97 | 52 | 71 | 0.0 | 2.7 |
| 20200722 | 20.1 | 9.5 | 15.5 | 97 | 40 | 67 | 0.0 | 1.8 |
| 20200723 | 24.6 | 12.2 | 18.9 | 81 | 42 | 60 | 0.0 | 4.1 |
| 20200724 | 21.9 | 15.9 | 18.6 | 90 | 63 | 78 | 0.6 | 3.5 |
| 20200725 | 22.5 | 16.2 | 18.3 | 98 | 70 | 87 | 29.4 | 5.0 |
| 20200726 | 21.3 | 16.2 | 18.5 | 92 | 56 | 73 | 1.7 | 5.6 |
| 20200727 | 26.1 | 15.6 | 19.0 | 85 | 52 | 73 | 0.1 | 5.4 |
| 20200728 | 20.2 | 15.4 | 17.8 | 85 | 58 | 67 | <0.1 | 5.7 |
| 20200729 | 20.7 | 12.1 | 16.5 | 84 | 54 | 67 | 0.0 | 3.4 |
| 20200730 | 25.9 | 12.7 | 19.9 | 85 | 37 | 61 | 0.0 | 2.1 |
| 20200731 | 32.2 | 14.5 | 25.3 | 83 | 31 | 52 | 0.2 | 4.0 |
| 20200801 | 24.2 | 16.0 | 20.3 | 91 | 58 | 79 | 0.3 | 3.8 |
| 20200802 | 21.4 | 12.7 | 17.7 | 92 | 52 | 73 | 0.0 | 3.0 |
| 20200803 | 19.1 | 11.7 | 15.6 | 97 | 68 | 83 | 4.1 | 2.1 |
| 20200804 | 21.9 | 9.4 | 17.2 | 97 | 43 | 65 | 0.0 | 2.4 |
| 20200805 | 27.6 | 15.1 | 20.8 | 83 | 32 | 58 | 0.0 | 4.3 |
| 20200806 | 29.2 | 15.3 | 22.3 | 93 | 38 | 68 | 0.0 | 2.0 |
| 20200807 | 32.9 | 16.5 | 25.3 | 97 | 27 | 61 | 0.0 | 1.7 |
| 20200808 | 33.8 | 16.9 | 26.5 | 96 | 27 | 57 | 0.0 | 2.1 |
| 20200809 | 31.6 | 20.3 | 26.1 | 87 | 50 | 67 | 0.0 | 3.4 |
| 20200810 | 32.4 | 19.0 | 25.6 | 88 | 40 | 65 | <0.1 | 3.2 |
| 20200811 | 32.5 | 19.4 | 25.9 | 83 | 48 | 65 | 0.0 | 2.5 |
| 20200812 | 31.6 | 20.1 | 26.6 | 87 | 47 | 64 | 0.0 | 3.0 |
| 20200813 | 31.4 | 20.2 | 25.0 | 96 | 53 | 75 | 1.5 | 2.3 |
| 20200814 | 28.1 | 18.5 | 22.0 | 97 | 58 | 84 | <0.1 | 2.5 |
| 20200815 | 27.3 | 17.3 | 21.8 | 98 | 57 | 82 | 10.5 | 1.7 |
| 20200816 | 29.8 | 17.1 | 22.4 | 98 | 53 | 83 | 4.7 | 2.8 |
| 20200817 | 24.7 | 16.0 | 19.7 | 98 | 65 | 86 | 2.7 | 2.3 |
| 20200818 | 23.0 | 15.3 | 18.9 | 93 | 57 | 80 | 1.4 | 3.5 |
| 20200819 | 27.7 | 15.6 | 21.7 | 95 | 49 | 72 | 1.9 | 4.6 |
| 20200820 | 28.9 | 19.2 | 23.2 | 94 | 59 | 81 | 0.7 | 3.5 |

| *date* | *air temperature max* | *air temperature min* | *air temperature average* | *% humidity max* | *% humidity min* | *% humidity average* | *precipi-tation total (mm)* | *wind-speed (m/s)* |
|---|---|---|---|---|---|---|---|---|
| 20200821 | 27.4 | 18.9 | 23.6 | 75 | 46 | 63 | <0.1 | 6.1 |
| 20200822 | 22.2 | 17.2 | 19.4 | 88 | 58 | 73 | 1.5 | 8.0 |
| 20200823 | 20.9 | 15.0 | 17.9 | 94 | 64 | 78 | 6.2 | 5.9 |
| 20200824 | 20.8 | 14.2 | 17.3 | 95 | 60 | 78 | 5.5 | 4.3 |
| 20200825 | 21.8 | 15.4 | 17.7 | 94 | 65 | 82 | 3.0 | 7.6 |
| 20200826 | 18.9 | 12.2 | 16.9 | 93 | 71 | 79 | 4.1 | 9.1 |
| 20200827 | 20.7 | 13.5 | 17.1 | 97 | 63 | 81 | 1.7 | 3.1 |
| 20200828 | 20.7 | 14.2 | 16.8 | 89 | 66 | 81 | 7.3 | 5.4 |
| 20200829 | 18.9 | 12.7 | 15.2 | 97 | 76 | 89 | 7.7 | 3.6 |
| 20200830 | 18.9 | 12.3 | 15.6 | 98 | 71 | 85 | 1.8 | 4.2 |
| 20200831 | 18.7 | 8.8 | 14.3 | 97 | 55 | 74 | 0.0 | 2.1 |
| 20200901 | 18.2 | 9.2 | 13.8 | 97 | 61 | 82 | 0.0 | 1.3 |
| 20200902 | 20.6 | 6.8 | 14.5 | 98 | 57 | 80 | 0.0 | 1.5 |
| 20200903 | 20.6 | 13.6 | 17.3 | 98 | 76 | 87 | 9.5 | 6.3 |
| 20200904 | 20.5 | 15.4 | 17.4 | 95 | 60 | 79 | 0.3 | 4.6 |
| 20200905 | 18.4 | 10.3 | 15.1 | 96 | 59 | 78 | 4.6 | 3.3 |
| 20200906 | 19.2 | 9.2 | 14.6 | 98 | 58 | 79 | 0.5 | 2.7 |
| 20200907 | 20.9 | 10.6 | 16.3 | 99 | 58 | 78 | 0.0 | 4.0 |
| 20200908 | 19.2 | 15.9 | 17.7 | 97 | 81 | 89 | <0.1 | 4.2 |
| 20200909 | 21.6 | 9.6 | 17.3 | 97 | 74 | 89 | 0.1 | 3.9 |
| 20200910 | 19.4 | 9.1 | 14.2 | 99 | 55 | 79 | 0.0 | 1.0 |
| 20200911 | 19.7 | 11.3 | 15.0 | 98 | 54 | 77 | 0.0 | 1.8 |
| 20200912 | 19.6 | 12.4 | 15.9 | 95 | 69 | 83 | 0.0 | 4.0 |
| 20200913 | 21.9 | 12.8 | 17.2 | 99 | 65 | 84 | 0.0 | 3.4 |
| 20200914 | 28.2 | 10.6 | 19.4 | 99 | 42 | 78 | 0.0 | 1.8 |
| 20200915 | 32.2 | 12.7 | 22.2 | 98 | 42 | 74 | 0.0 | 1.5 |
| 20200916 | 23.1 | 13.2 | 18.4 | 99 | 64 | 83 | 0.0 | 3.7 |
| 20200917 | 19.4 | 8.5 | 13.8 | 97 | 44 | 71 | 0.0 | 4.3 |
| 20200918 | 21.5 | 6.3 | 13.7 | 86 | 44 | 69 | 0.0 | 4.6 |
| 20200919 | 23.3 | 6.9 | 15.4 | 89 | 42 | 67 | 0.0 | 3.5 |
| 20200920 | 21.9 | 9.0 | 14.8 | 96 | 45 | 70 | 0.0 | 3.5 |
| 20200921 | 24.1 | 6.6 | 14.9 | 99 | 35 | 79 | 0.0 | 1.4 |
| 20200922 | 22.9 | 7.4 | 15.3 | 99 | 45 | 78 | 0.0 | 1.3 |
| 20200923 | 20.8 | 14.6 | 16.9 | 94 | 66 | 87 | 22.0 | 4.8 |
| 20200924 | 17.2 | 11.4 | 13.9 | 86 | 62 | 78 | 1.4 | 6.8 |
| 20200925 | 13.2 | 7.8 | 11.3 | 97 | 75 | 86 | 12.9 | 6.8 |
| 20200926 | 16.8 | 8.1 | 12.9 | 95 | 68 | 84 | 12.0 | 3.3 |
| 20200927 | 17.0 | 13.3 | 14.9 | 98 | 74 | 87 | 5.4 | 5.0 |
| 20200928 | 16.8 | 13.5 | 15.2 | 98 | 95 | 98 | 15.1 | 1.8 |
| 20200929 | 18.8 | 13.2 | 15.7 | 98 | 57 | 82 | 3.2 | 2.6 |
| 20200930 | 19.1 | 12.0 | 15.8 | 98 | 77 | 88 | 1.2 | 4.0 |

## Annex L Raw data yield assessment

**Table L.1.** Harvest data of the field trial in Westmaas (18th of September, 2020).

| *treatment* | *replicate* | *root weight (ton/ha)* | *percentage of sugar* | *sugar weight (ton/ha)* | *soil tare (%)* | *potassium (mmol/kg)* | *sodium content (mmol/kg)* | *amino nitrogen (mmol/kg)* | *financial yield (€/ha)* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 112.5 | 16.09 | 18.1 | 2.3 | 36.8 | 2.6 | 13.9 | 3554 |
| 1 | B | 126.8 | 16.33 | 20.7 | 1.6 | 37.0 | 2.6 | 12.8 | 4129 |
| 1 | C | 121.8 | 16.24 | 19.8 | 1.8 | 38.8 | 2.6 | 12.0 | 3924 |
| 1 | D | 125.9 | 16.31 | 20.5 | 1.9 | 36.4 | 2.4 | 13.9 | 4080 |
| 2 | A | 107.2 | 16.01 | 17.2 | 2.2 | 35.4 | 2.6 | 13.0 | 3373 |
| 2 | B | 121.5 | 16.12 | 19.6 | 2.4 | 36.6 | 2.8 | 14.0 | 3851 |
| 2 | C | 109.9 | 15.85 | 17.4 | 3.3 | 35.1 | 2.4 | 12.6 | 3385 |
| 2 | D | 112.7 | 15.95 | 18.0 | 1.8 | 36.5 | 2.6 | 11.7 | 3529 |
| 3 | A | 122.3 | 16.59 | 20.3 | 2.4 | 31.7 | 2.3 | 12.8 | 4103 |
| 3 | B | 113.7 | 15.65 | 17.8 | 1.5 | 35.5 | 2.9 | 13.6 | 3443 |
| 3 | C | 115.2 | 16.03 | 18.5 | 2.3 | 38.0 | 2.7 | 13.7 | 3613 |
| 3 | D | 119.5 | 16.26 | 19.4 | 1.7 | 36.2 | 2.4 | 10.8 | 3876 |
| 4 | A | 119.4 | 16.27 | 19.4 | 2.1 | 36.2 | 2.5 | 11.6 | 3867 |
| 4 | B | 120.1 | 16.10 | 19.3 | 2.3 | 36.1 | 2.6 | 13.1 | 3808 |
| 4 | C | 119.4 | 16.06 | 19.2 | 2.0 | 36.7 | 2.3 | 12.2 | 3775 |
| 4 | D | 115.7 | 15.86 | 18.4 | 2.2 | 35.7 | 2.9 | 15.1 | 3565 |
| 5 | A | 128.1 | 16.44 | 21.1 | 2.0 | 34.5 | 2.2 | 11.4 | 4233 |
| 5 | B | 121.7 | 15.95 | 19.4 | 2.2 | 34.9 | 2.7 | 13.1 | 3805 |
| 5 | C | 124.7 | 17.00 | 21.2 | 2.0 | 37.5 | 2.5 | 13.8 | 4325 |
| 5 | D | 107.8 | 15.73 | 17.0 | 1.9 | 36.8 | 2.9 | 12.6 | 3286 |
| 6 | A | 112.7 | 16.61 | 18.7 | 2.7 | 33.4 | 2.3 | 10.5 | 3787 |
| 6 | B | 114.3 | 16.13 | 18.4 | 1.8 | 37.6 | 2.5 | 12.2 | 3644 |
| 6 | C | 107.5 | 16.15 | 17.4 | 2.0 | 36.6 | 2.6 | 13.2 | 3427 |
| 6 | D | 121.7 | 16.06 | 19.5 | 2.2 | 34.7 | 2.4 | 12.4 | 3853 |
| 7 | A | 128.7 | 16.49 | 21.2 | 2.4 | 36.3 | 2.2 | 11.6 | 4256 |
| 7 | B | 112.6 | 16.07 | 18.1 | 2.0 | 37.2 | 2.8 | 14.3 | 3551 |
| 7 | C | 119.2 | 16.31 | 19.5 | 2.0 | 36.7 | 2.5 | 12.5 | 3874 |
| 7 | D | 108.0 | 16.35 | 17.6 | 2.2 | 34.2 | 2.4 | 10.6 | 3536 |
| 8 | A | 119.8 | 16.30 | 19.5 | 3.2 | 35.2 | 2.7 | 10.8 | 3882 |
| 8 | B | 114.7 | 15.79 | 18.1 | 2.1 | 36.7 | 3.0 | 13.7 | 3511 |
| 8 | C | 123.3 | 16.09 | 19.8 | 2.8 | 37.5 | 2.5 | 12.7 | 3893 |
| 8 | D | 112.3 | 16.61 | 18.7 | 2.2 | 37.1 | 2.4 | 11.0 | 3766 |
| 9 | A | 113.5 | 16.30 | 18.5 | 1.6 | 35.4 | 2.4 | 11.6 | 3699 |
| 9 | B | 109.8 | 15.88 | 17.4 | 1.4 | 35.9 | 2.6 | 12.2 | 3421 |
| 9 | C | 120.6 | 16.13 | 19.5 | 2.1 | 36.4 | 2.5 | 12.0 | 3846 |
| 9 | D | 123.3 | 16.37 | 20.2 | 1.6 | 36.0 | 2.5 | 12.0 | 4040 |
| 10 | A | 125.4 | 16.85 | 21.1 | 1.9 | 35.1 | 2.5 | 12.1 | 4312 |
| 10 | B | 118.3 | 15.95 | 18.9 | 2.2 | 36.6 | 2.6 | 15.3 | 3677 |
| 10 | C | 120.5 | 16.69 | 20.1 | 1.6 | 34.6 | 2.2 | 10.4 | 4095 |
| 10 | D | 127.0 | 16.16 | 20.5 | 0.5 | 34.2 | 2.5 | 12.5 | 4097 |

| *treatment* | *replicate* | *root weight (ton/ha)* | *percentage of sugar* | *sugar weight (ton/ha)* | *soil tare (%)* | *potassium (mmol/kg)* | *sodium content (mmol/kg)* | *amino nitrogen (mmol/kg)* | *financial yield (€/ha)* |
|---|---|---|---|---|---|---|---|---|---|
| 11 | A | 114.8 | 16.10 | 18.5 | 2.3 | 35.6 | 2.4 | 12.5 | 3648 |
| 11 | B | 109.3 | 15.23 | 16.7 | 2.8 | 35.1 | 3.4 | 14.5 | 3129 |
| 11 | C | 119.0 | 15.94 | 19.0 | 1.2 | 39.4 | 2.8 | 12.9 | 3714 |
| 11 | D | 125.0 | 16.84 | 21.1 | 1.8 | 34.2 | 2.5 | 12.0 | 4300 |
| 12 | A | 118.6 | 16.62 | 19.7 | 4.8 | 36.4 | 2.1 | 11.0 | 3943 |
| 12 | B | 123.7 | 15.83 | 19.6 | 2.8 | 37.5 | 2.7 | 15.3 | 3777 |
| 12 | C | 115.7 | 16.09 | 18.6 | 2.4 | 34.2 | 2.6 | 12.0 | 3679 |
| 12 | D | 109.4 | 16.19 | 17.7 | 2.4 | 34.9 | 2.5 | 12.3 | 3510 |
| 13 | A | 113.8 | 15.74 | 17.9 | 2.0 | 33.9 | 2.6 | 13.3 | 3479 |
| 13 | B | 115.1 | 15.43 | 17.8 | 2.6 | 35.5 | 3.1 | 14.7 | 3370 |
| 13 | C | 104.5 | 15.45 | 16.1 | 2.8 | 38.8 | 2.9 | 15.4 | 3048 |
| 13 | D | 111.0 | 15.51 | 17.2 | 2.3 | 38.0 | 2.8 | 15.8 | 3272 |
| 14 | A | 101.3 | 15.13 | 15.3 | 2.7 | 36.8 | 3.0 | 14.9 | 2858 |
| 14 | B | 110.7 | 15.56 | 17.2 | 2.1 | 35.7 | 2.9 | 13.4 | 3310 |
| 14 | C | 99.4 | 15.78 | 15.7 | 2.6 | 37.9 | 2.5 | 13.6 | 3031 |
| 14 | D | 116.5 | 15.43 | 18.0 | 2.8 | 38.4 | 2.9 | 16.3 | 3391 |
| 15 | A | 109.5 | 15.58 | 17.1 | 3.1 | 36.0 | 2.5 | 13.6 | 3266 |
| 15 | B | 113.9 | 15.85 | 18.1 | 2.2 | 37.5 | 2.7 | 12.2 | 3516 |
| 15 | C | 110.3 | 15.83 | 17.4 | 3.1 | 45.1 | 4.6 | 23.1 | 3279 |
| 15 | D | 115.6 | 15.72 | 18.2 | 1.9 | 34.6 | 2.7 | 12.5 | 3533 |